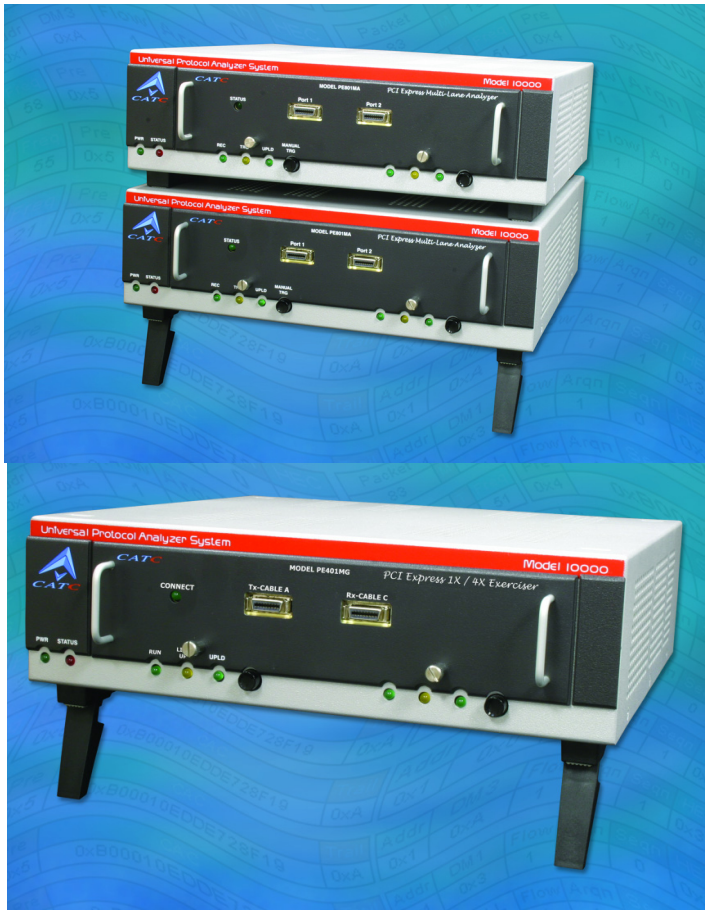
TELEDYNE LECROY
Everywhereyoulook™

PROTOCOL SOLUTIONS GROUP
3385 SCOTT BLVD
SANTA CLARA, CA 95054

PE*Tracer* ML™
PCI Express Multi-Lane Protocol Analyzer
PE*Trainer* ML™
PCI Express Multi-Lane Exerciser
User Manual



For Software Version 6.7x

September 2012

Document Disclaimer

The information in this document has been carefully checked and is believed to be reliable. However, no responsibility can be assumed for inaccuracies that may not have been detected.

Teledyne LeCroy reserves the right to revise the information in this document without notice or penalty.

Trademarks and Servicemarks

Teledyne LeCroy, CATC Trace, PCI Express, PETracer Edge, PETracer EML, PETracer ML, PETracer, PETrainer EML, PETrainer ML, PETracer Summit, Summit T2-16, Summit Z2-16, Universal Protocol Analyzer System, UPAS, and *BusEngine* are trademarks of Teledyne LeCroy.

Microsoft and *Windows* are registered trademarks of Microsoft Inc.

All other trademarks are property of their respective companies.

Copyright

© 2012 Teledyne LeCroy, Inc. All Rights Reserved.

This document may be printed and reproduced without additional permission, but all copies should contain this copyright notice.

WEEE Program

This electronic product is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

TABLE OF CONTENTS

Section 1. General. 1

Chapter 1 Overview 3

1.1 PETracer Analyzer Hardware and Software 3
1.2 PETrainer Exerciser Hardware 5
1.3 CATC Trace Software 6
1.4 PETracer ML Analyzer 7
1.5 PETrainer ML Exerciser 9
1.6 Other Documents 10

Chapter 2 Hardware Description 11

2.1 System Components 11
2.2 Host Machine Requirements 11
2.3 Universal Protocol Analyzer System (UPAS) 12
2.4 Protocol Analyzer Modules 12
2.5 PETrainer Exerciser 13
2.6 PETracer ML Analyzer LED Descriptions 14
2.7 PETrainer ML Exerciser LED Descriptions 15
2.8 Rear Panel Description 16
2.9 Specifications for PETracer ML/PETrainer ML 18
2.10 External Interface Breakout Board 21
Pin-Outs for the Data In/Out Connector 22
Prototype Rework Area 22
Breakout Board Input and Output Signals 23

Chapter 3 Installation 25

3.1 Installing the PETracer Software 25
3.2 Setting Up a PETracer Analyzer 27
3.3 Setting Up a PETrainer Exerciser 28
3.4 Installing a Dual Analyzer System 29
3.5 Networking an Analyzer 29
Setup for IP LAN Use 29
3.6 Browsing to a Networked Analyzer 30
3.7 Connecting the PETracer ML Analyzer to the Device Under Test 31
3.8 Connecting PETrainer ML to the Device Under Test 34

Section 2. PETracer Analyzer Software . . 41

Chapter 4 Software Overview 43

4.1 The PETracer Software 43
4.2 Application Layout 44
4.3 Using the Toolbar 45
Multi-Segment Toolbar 47
Traffic Generation Toolbar 48
Toolbar Hide Buttons 49

4.4 Using the Menus 51
4.5 Tool Tips 57
4.6 Keyboard Shortcuts 57
4.7 Status Bar 58
4.8 Making a PCI Express Recording 61
4.9 Recording Multi-Segmented CATC Traces 63
How to Create a Multisegment Recording 63
4.10 PETracer Files 65
CATC Trace Files 65
Recording Options Files 65
Display Options Files 65
4.11 Opening CATC Trace Files 66
4.12 Saving CATC Trace Files 67
Using the Save As Function 67
Saving a Portion of a CATC Trace 67
4.13 Exporting a CATC Trace File 68
4.14 Printing Data Files 69
4.15 Analyzer Chat Window 70

Chapter 5 Reading CATC Traces 71

5.1 Viewing PCI Express CATC Traces 71
5.2 Expand and Collapse Data Fields 71
5.3 Resizing Cells 71
5.4 Pop-up Menus 72
5.5 View Data Block 72
5.6 Show Raw 10b Codes 73
5.7 Show Header Fields 74
5.8 Packet Cell Popup Menus 75
Packet Header R-> Cell Popup Menu 75
Packet Header G1 Cell Popup Menu 76
5.9 Set Marker 77
5.10 Edit or Clear Marker 78
5.11 Decoding Traffic 79
Packet 79
Link 79
Split 79

Chapter 6 Searching CATC Traces 81

6.1 CATC Trace Search Overview 81
6.2 Go to Trigger 81
6.3 Go to Packet 81
6.4 Go to Time 82
6.5 Go to Marker 82
2. Markers 83
Markers Overview 83
Functionality of Markers 84
Attaching Markers 86
Adding an Attachment 86
5. Recording an Audio File 87
Video Files supported 87
Attachment Types and Visualization 88

Embedded Attachments to a Marker . . . 88
Viewing Attachments of a Marker . . . 89
Text . . . 89
Audio . . . 91
Video . . . 92
File Attachment . . . 92
URL Link . . . 92
YouTube Video . . . 93
Images . . . 94
Other Attachments . . . 94
Edit Marker . . . 94
All Markers Window . . . 95
6.6 CATC Walk Playlist . . . 97
Playlist Functionality . . . 98
Playback Window . . . 100
Playlist Playback Controls . . . 101
6.7 Go To Menu . . . 102
6.8 Search Direction . . . 103
6.9 Find . . . 104
Event Groups . . . 106
6.10 Search for the Next Packet Type . . . 106

Chapter 7 Display Options . . . 107

7.1 Setting Display Options . . . 107
7.2 Specifying General Display Options . . . 108
Analysis Tools Checkboxes . . . 108
Fonts . . . 108
Configuration Name . . . 109
7.3 Color, Format, and Hiding Options . . . 109
Setting Field Colors . . . 110
Changing Field Formats . . . 112
7.4 Load a Previously Saved Display Options File . . . 116
7.5 Saving Display Options . . . 116

Chapter 8 Recording Options . . . 117

8.1 Setting Recording Options . . . 117
8.2 General Tab . . . 118
Recording Type . . . 119
Buffer Size . . . 119
Target Analyzer . . . 120
Trigger Position . . . 120
Trigger On . . . 120
Trace Filename and Path . . . 120
Options Name . . . 121
Save As MultiSegment Trace . . . 122
Viewing Multisegmented Files . . . 122
Misc . . . 123
Link for PETrainer ML . . . 124
Saving and Loading Previously Saved Recording Options . . . 126
Setting Default Recording Options . . . 126
8.3 Recording Rules Overview . . . 127
Global State vs. Sequences . . . 128

8.4 Recording Rules Buttons 129
8.5 Creating Recording Rules 129
8.6 Recording Rule Limits 132
Configuration Limitations in PETracer ML 132
8.7 Recording Rules Logic: How Contradictory Rules are Resolved 134
Recording Rules Examples 134
8.8 Properties Dialog Boxes 141
8.9 Event Properties Dialog 142
Accessing the Properties Dialog 142
Dialog Settings and Features 142
Error Properties Dialog 143
Actions Properties Dialog 143
TLP Header Properties Dialog 144
TLP Prefix Properties Dialog 144
Payload Properties Dialog 145
DLLP Packet Properties Dialog 145
Ordered Set Properties Dialog 146
8.10 Counting Events 146
8.11 Creating a Payload Match 148
8.12 Trigger 150
8.13 Filter In and Filter Out 151

Chapter 9 Reports and Tools 153

9.1 File Information 154
9.2 Error Summary 155
9.3 Traffic Summary 156
Using the Traffic Summary Window to Search the CATC Trace 156
Traffic Summary Buttons 157
9.4 Bus Utilization 158
Bus Utilization Pop-up Menu 159
Bus Utilization Buttons 161
9.5 Link Tracker 163
Using the Link Tracker Window 164
Link Tracker Buttons 167
9.6 Data Flow Window 169
9.7 Using the Trace Navigator 170
Displaying the Navigator 170
Navigator Toolbar 171
Navigator Ranges 171
Navigator Panes 173
9.8 LTSSM Flow Graph 176
9.9 Packet Header Bar 177
9.10 Packet Data Window 178
9.11 Configuration Space View 179
9.12 Using Unit Metrics 181
Show Metrics in the CATC Trace Display 182
Show Metrics in the Traffic Summary Window 184
Show Metrics in the Bus Utilization Window 186
9.13 Real-Time Statistics Window 189
Real-Time Statistics Buttons 190
Real-Time Statistical Monitor Pop-up Menu 192

Real-Time Statistics Graph Areas 193
9.14 TC to VC Mapping 195
9.15 Timing and Bus Usage Calculations 196
9.16 Running Verification Scripts 198

Section 3. PETrainer Exerciser Traffic Generation 201

Chapter 10 Traffic Generation 203
10.1 Theory of Operation 203
10.1 Traffic Generation Files 205
10.2 Creating a Traffic Generation File 207
Exporting a CATC Trace to a Traffic Generation File 207
Saving a PETrainer Script to a New File 208
Creating a New Empty Generation File 209
10.3 Editing Generation Files with the Script Editor 210
Script Editor Toolbar 211
Script Edit Window 212
Command Properties Window 214
Script Editor File Tabs 215
Script Editor Error Log 215
View Options Menu 216
10.4 Generation Options Dialogs Overview 217
Opening the Dialog 217
10.5 Generation Options for PETrainer ML 218
General 218
Link 220
Integrity 221
Flow Control 223
Transactions 225
10.6 Generating Traffic: Set Generation Options 226
10.7 Generating Traffic: Prepare Traffic Generation 227
10.8 Generating Traffic: Begin Traffic Generation 228

Chapter 11 Macros 231
11.1 Macros 231
Default Macros: Connect and Disconnect 231
11.2 Adding New Script Macros 232
Using the Generation Macros Dialog 232
Adding Script Files to the GenScriptMacros Directory 233
11.3 Modifying Script Macros 234
11.4 Changing the Order of Macro Icons on the Status Bar 234
11.5 Deleting User-Defined Script Macros 235
11.6 Restoring the Default Appearance of the Connect and Disconnect Icons . . 235

Chapter 12 Address Space. 237
12.1 Address Space Toolbar Buttons and Dialogs 237
Write Address Space Button 238
Read Address Space Button 238
12.2 Memory/IO Space Editor 239
Chapter 13 Configuration Space 241
13.1 Configuration Space Editor 241
13.2 Launching the Configuration Space Editor 241
Configuration Space Files 241
Editing 242
13.3 BARs Setup 245
13.4 Configuration Read and Write 246
Chapter 14 Updates and Licensing 247
14.1 Updating the Analyzer 247
14.2 License Keys 248
14.3 License Information 248
Appendix A Configuration Space Decoding 249
A.1 Mandatory Definitions 249
A.2 Mandatory Module Functions 249
A.3 Configuration Register Types 250
A.4 Primitives 250
A.5 Helper File 251
Appendix B China Restriction of Hazardous Substances Table252
How to Contact Teledyne LeCroy 253
Index 255

Section 1. General

Chapter 1: Overview

Designed for developers and validators, the Teledyne LeCroy PE*Tracer/Trainer* ML™ is a PCI Express™ Multi-Lane advanced verification system.

By leveraging years of experience in protocol analysis tools for emerging markets, PE*Tracer/Trainer* ML blends sophisticated functionality with practical features to speed the development of PCI Express™ IP cores, semiconductors, bridges, switches, add-in boards, and systems.

1.1 PE*Tracer* Analyzer Hardware and Software

Features and Benefits

PE*Tracer* ML Analyzers have these features and benefits:

Features	Benefits
Powerful and Intuitive CATC Trace™ Analysis Software	Faster interpretation and debug of PCI Express traffic with color-coded, clearly labeled protocol elements in a graphical display. Reduces coding and deciphering.
Extensive Decoding	Complete, accurate and reliable decoding of TLPs (Transaction Layer Packets), DLLPs (Data Link Layer Packets), and all PCI Express Primitives
Monitoring and Link Utilization	View link utilization and other performance measurements changing in real time. Save this data to view as post-session statistics.
Advanced Triggering	Isolate important traffic, specific errors, or data patterns. Trigger condition setup is made simple with drag and drop tools to link events to trigger or filter actions.
Hardware Filtering	Analyze faster and understand transactions more clearly by removing non-essential fields from the CATC Trace.
Intelligent Reporting	Quickly identify and track error rates and abnormal link or timing conditions. Display configuration space and protocol specification details.
Sophisticated Viewing	View Packet, Link and Split Transaction levels of the PCI Express protocol. Collapsible/expandable headers with Tool tip explanations make it easy to navigate and interpret packet contents, headers, and commands. View packets, transactions of TLPs and DLLPs in classic CATC Trace™ format or in raw 10b code for deeper analysis.

2 GB Recording Capacity	Capture long recording sessions for analysis and problem solving
Hi-Speed USB Port	Access PCI Express recordings up to 40x faster than USB 1.1. No complicated setup required.
Downloadable Trace Viewer	Share and annotate CATC Trace recordings within a development team. Freely distributable PE*Tracer* software enables collaborative analysis across sites and time zones.
Taps non-intrusively into a single x1, 2.5 gigabit/second PCI Express port using MicroGigaCN receptacle and one standard x4 cable	Accurate and non-intrusive collection of PCI Express CATC Trace data
Field-upgradeable firmware and recording engine	Upgrades available for download direct from the Teledyne LeCroy website
Flexible probing options	Active and passive slot interposers MidBus probe Flying lead probe Gen1 AMC interposer Gen1 XMC interposer Gen1 SIOM interposer Gen1 Express card interposer
External interface for probing and monitoring auxiliary digital signals	Enables cross triggering between other test instruments.
Dword to Transaction Level Viewer	View Dwords, Packet, Link and Split Transaction levels of the PCI Express protocol.
CRC checking	Know that info being displayed is accurate.

1.2 PE*Trainer* Exerciser Hardware

Features and Benefits

PE*Trainer* ML Exercisers have these features and benefits

Features	Benefits
Script level traffic generation	Programmability to test PCI Express components with more precision and control
Convert CATC Trace files into generation scripts	Recreate failure scenarios by replaying recorded traffic
Manual Error injection	Verify fault handling and identify error recovery
Host/End-Point Emulation Support	Host emulation platform/end-point emulation Interposer allows for design and stress testing.
Programmable Physical Layer	Flexibility to program lane skews, link control bits, skip intervals and link states for more robust verification
Programmable Data Link Layer	Ability to modify flow control, ACK/NAK, and retry behaviors
Flexible/programmable Transaction Layer	User ability to define arbitrary sequence of transactions, payload generation, and conditional repeat of transactions provide users with maximum flexibility
Raw Generation mode	Allows complete control of each symbol transmitted
Programmable reply timers	Allows testing of ACK latency timeouts and retry mechanisms
Point and Click Script Editor	Complex scripts can be created quickly and easily
Error Insertion	CRC Errors Running Disparity Errors Insertion of Invalid 10-bit symbols Lane to Lane Skew Insertion Lane Reversal Polarity Inversion

Programmable ACK/NAK behavior	ACK all TLP packets NAK all TLP packets Automatic ACK/NAK behavior ACK/NAK delay timer
Programmable Flow control behavior	Set Credit values Disable Credit checking Set Update InitFC intervals
Automatic CRC calculation and Sequence number assignment	DLLP CRC calculation TLP LCRC calculation
Replay buffer	Programmable Transaction timeout timer Auto Recovery behavior after 4 Replays
Programmable configuration space	Full 4 KB configuration space configurable by user Accessible through Configuration Reads and Writes over PCI Express

1.3 CATC Trace Software

PE*Tracer* ML utilizes the CATC Trace™ to assist users in analyzing how PCI Express components work together, diagnose problems, and test for interoperability and standards compliance.

The CATC Trace is a powerful and intuitive expert software system embedding detailed knowledge of the protocol hierarchy and intricacies, as defined in the protocol specification. The software allows the user to control the Analyzer and set specific real-time triggering and filtering conditions. The CATC Trace utilizes a Windows-based graphical display that has been optimized for fast and easy navigation through a captured traffic session. Users are alerted as violations are detected at all levels of the protocol layering and can easily drill down on areas of interest or collapse and hide fields that are not relevant.

1.4 PE*Tracer* ML Analyzer

The Teledyne LeCroy PE*Tracer* ML hardware taps transparently into the fabric to capture, decode, and display x1, x2, x4 and x8 bidirectional transfers of PCI Express traffic. Developers use the CATC Trace™ expert software system to define recording, triggering and filtering conditions and to view, analyze and print the CATC Trace.

PE*Tracer* ML uses a high impedance, non-intrusive probing technology, allowing full, unaltered data pass-through. The Analyzer offers a dual approach in tapping into the PCI Express fabric. Whether the design utilizes a card-edged solution, or implements the PCI Express link between circuit board components, PE*Tracer* ML provides support for both a Slot Interposer card and a mid-bus probe (for more information about mid-bus probes, refer to the *PETracer Mid-Bus Probe™ Installation Guide*).

A single PE*Tracer* ML Analyzer supports bidirectional x1, x2 and x4 links, as well as unidirectional x8 PCI Express link data capture and analysis. Combining two PE*Tracer* ML Analyzer systems allows for full bidirectional decode and capture of a x8 PCI Express link.

PE*Tracer* ML has many innovative features that dramatically reduce time-to-market for PCI Express solutions, including a comprehensive set of triggering and filtering options that allow the user to capture traffic that is of most interest and relevance.

Users are provided with a list of protocol events from link conditions to error violations, which enables them to set commands to the Analyzer to search, isolate and capture the essential data.

PE*Tracer* ML provides accurate, reliable and complete decodes of Transaction Layer Packets (TLPs), Data Link Layer Packets (DLLPs) and all PCI Express primitives. For deeper analysis, you can display packet contents as raw 10-bit codes.

The PE*Tracer* ML Multi-Lane PCI Express Protocol Analyzer is a hardware module that installs into the Teledyne LeCroy Universal Protocol Analyzer System™ (UPAS™) 10000. The UPAS 10000 is a base system designed to accommodate different protocol modules.

Together, PE*Tracer* ML and the UPAS connect to a host machine that runs the PE*Tracer* user interface. This interface administers the Analyzer, displays CATC Traces, and analyzes the performance of the devices under test.

PE*Tracer* ML supports the pairing of two UPAS/PE*Tracer* ML. Pairing doubles the width of the PCI Express bidirectional link that can be monitored from x4 to x8.

PE*Tracer* ML uses hardware triggering to capture real-time events, and hardware filtering to filter in or out different types of packets from the recording. Filtering allows users to focus recordings on events of interest and to preserve recording memory so that the recording time can be extended. All traffic is recorded non-intrusively, meaning that PE*Tracer* ML does not adversely affect the link it is recording.

Recorded data is presented in colored graphics in a CATC Trace viewer application. This application has advanced search and viewing capabilities that allow the user to quickly locate specific data, errors, and other desired conditions, thereby focusing the user's attention on events of interest.

The PE*Tracer* ML Protocol Analyzer functions with any personal computer using the Microsoft® Windows® XP or Vista operating system and equipped with a functional USB interface.

PE*Tracer* ML provides on-the-fly detection of and triggering on PCI Express events. Whether recording manually or with a specified trigger condition, PE*Tracer* ML continuously records the link data in a wrap-around fashion until manually stopped or until the Trigger Event is detected and a specified amount of post-Trigger link data is recorded.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by the user. Real-time detection of events can be individually enabled or disabled to allow triggering on events as they happen. This includes predefined exception or error conditions and a user-defined set of trigger events. The unit can also be triggered by an externally supplied signal. An external DB-25 connector provides a path for externally supplied data or timing data to be recorded along with traffic.

This DB-25 connector also provides a path for PE*Tracer* ML to transmit signals externally for purposes of probing and use by other circuitry.

The PE*Tracer* ML software provides powerful search functions that enable investigation of particular events and allow the software to identify and highlight specific events. In addition to immediate analysis, you can print any part of the data. Use the **Save As** feature to save the data on disk for later viewing. The program also provides a variety of timing information and data analysis reports.

1.5 PE*Trainer* ML Exerciser

The Teledyne LeCroy PE*Trainer*™ ML™ is a Multi-lane PCI Express (x1, x4) Exerciser designed to assist engineers in improving reliability of their solutions and providing advanced capabilities for stress and compliance testing. Together with the Teledyne LeCroy PE*Tracer* ML expert PCI Express protocol analysis solutions, PE*Trainer* ML reduces time to market by enabling users to quickly identify logic and design flaws.

PE*Trainer* ML is designed as a stand alone Multi-lane PCI Express Exerciser that is capable of generating and responding to all types of PCI Express transactions while allowing users to create protocol variations and anomalies. The users may also create corner case and stress test scenarios to evaluate the robustness of their solutions. By utilizing the PE*Trainer* ML error injection feature, engineers can create worst-case PCI Express traffic scenarios allowing them to validate the error handling capabilities of their solutions.

When PE*Trainer* ML is used in conjunction with the Teledyne LeCroy PE*Tracer* ML or Teledyne LeCroy PE*Tracer* Analyzer, a complete expert test and analysis system is created. This integrated solution delivers traffic generation and expert protocol analysis to assist developers with early validation of designs along with error injection and stress testing in preparation for compliance testing.

1.6 Other Documents

For more information about PE*Tracer* and PE*Trainer*, refer to the following documents:

- *Teledyne LeCroy Analyzers File-based Decoding Manual*
- *PETracer/Trainer Automation Manual*
- *PETracer VSE Manual*
- *PETracer Gen2 Multi Lead Probe User Manual*
- *PETrainer Scripting Language Reference Manual*
- PE*Tracer* Online Help

Chapter 2: Hardware Description

The PCI Express™ system features the Universal Protocol Analyzer System™ (UPAS™), PE*Tracer*™ Analyzers, and PE*Trainer*™ Exercisers.

2.1 System Components

- **PE*Tracer* ML system (based on the UPAS 10K platform):**
  - Factory-installed PE*Tracer* ML™ Analyzer module(s)
  - One USB cable
  - Probe data cable
  - Breakout Board with cable
  - PE*Tracer* Software program CD-ROM
  - User Manual
  - PCI Express Slot Interposer probe

- **PE*Trainer* ML system (based on the UPAS 10K platform):**
  - Factory-installed PE*Trainer* ML™ Exerciser module
  - One USB cable
  - Probe data cable
  - Breakout Board with cable
  - PE*Tracer* Software program CD-ROM
  - Device Emulation Interposer or Host Emulation Test Fixture

2.2 Host Machine Requirements

PE*Tracer* ML and PE*Trainer* ML connect to a host machine. Please consult the **readme** file on the installation CD for the latest host machine requirements.

2.3 Universal Protocol Analyzer System (UPAS)

The Universal Protocol Analyzer System (UPAS) is a base unit for Teledyne LeCroy protocol Analyzer modules. The UPAS contains the recording memory and other resources used by all Teledyne LeCroy Analyzer modules. At the back of the UPAS is a hi-speed USB port for transferring CATC Trace data to a host machine.

- **UPAS 10K**: Supports the PE*Tracer* ML™.

2.4 Protocol Analyzer Modules

PE*Tracer* ML hardware modules plug into Teledyne LeCroy's Universal Protocol Analyzer System (UPAS).

- **PE*Tracer* ML**: Multi-lane version of PE*Tracer*. It works with the UPAS 10K and occupies both slots of the UPAS.

Analyzer modules use hardware triggering to capture real-time events and hardware filtering to exclude unwanted data. Data is recorded into the Analyzer's buffer and then transferred over a USB line to a host machine for display and analysis. Search and display capabilities in the Analyzer software allow you to quickly locate specific data, errors and other desired conditions.

An external DB-25 connector provides a path for externally supplied data or timing information to be recorded along with link traffic.

2.5 PE*Trainer* Exciser

PE*Trainer*™ is a Multi-lane PCI Express Exerciser designed to assist engineers in improving reliability of their solutions and providing advanced capabilities for stress and compliance testing.

- PE*Trainer* ML™: 4-lane system

All PE*Trainer* models operate as standalone Exercisers capable of generating and responding to all types of PCI Express transactions. Both Exercisers also have the ability to create protocol variations and anomalies. Users may also create corner case and stress test scenarios to evaluate the robustness of their solutions. By utilizing the PE*Trainer* error injection feature, engineers can create worst-case PCI Express traffic scenarios allowing them to validate the error handling capabilities of their solutions.

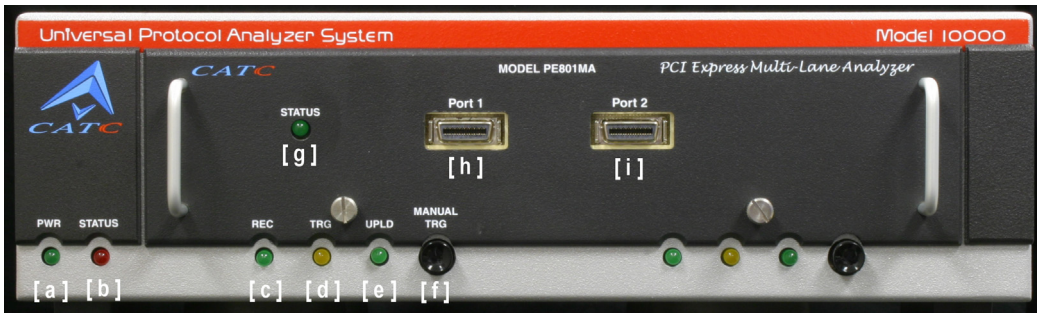
When PE*Trainer* is used in conjunction with a PE*Tracer* Analyzer, a complete expert test and analysis system is created. This integrated solution delivers traffic generation and expert protocol analysis to assist developers with early validation of designs along with error injection and stress testing in preparation for compliance testing.

2.6 PE*Tracer* ML Analyzer LED Descriptions

When powered on, the PE*Tracer* ML activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

Warning! Do not open the UPAS enclosure. There are no operator serviceable parts inside. Refer servicing to Teledyne LeCroy.

UPAS LEDs (from left to right)



(a) Green **PWR** (power) indicator LED for UPAS: lights when the unit power is switched on.

(b) Red **Status** indicator LED for UPAS: lights during initialization/power up of UPAS base unit. Blinks if a self-test fails.

The following LEDs and the **Manual Trigger** button on the UPAS function in conjunction with the PE*Tracer* ML module inserted above it:

(c) Green **REC** (recording) LED: lights when the unit is recording.

(d) Orange **TRG** (triggered) LED: lights when the unit triggers on an event.

(e) Green **UPLD** (Upload): lights when unit is uploading data to host machine.

(f) **Manual Trigger** push-button: allows a manual CATC Trace capture.

LEDs and Connectors on the PE*Tracer* ML Module

(g) Green **Status** LED: Illuminates when there is traffic on the link.

(h) **Probe Data Connector**

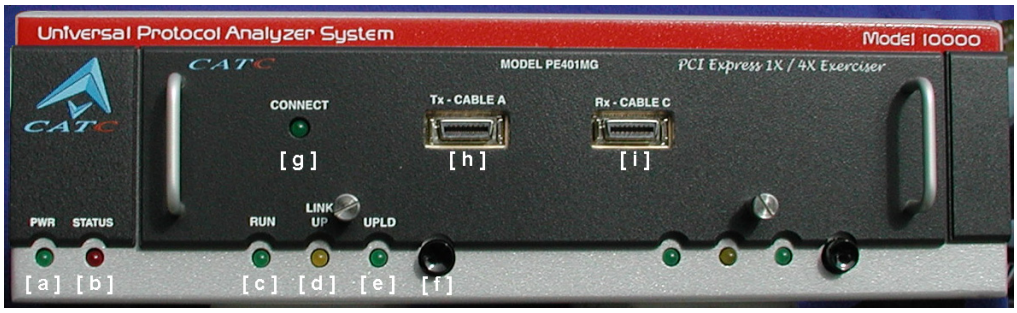
(i) **Probe Data Connector**

2.7 PE*Trainer* ML Exerciser LED Descriptions

When powered on, the PE*Trainer* ML activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

Warning! Do not open the UPAS enclosure. There are no operator serviceable parts inside. Refer servicing to Teledyne LeCroy.

UPAS LEDs (from left to right)



(a) Green **PWR** (power) indicator LED for UPAS: Lights when the unit power is switched on.

(b) Red **Status** indicator LED for UPAS: Lights during initialization/power up of UPAS base unit. Blinks if a self-test fails.

The following LEDs on the UPAS function in conjunction with the PE*Trainer* ML module inserted above it:

(c) Green **Run** LED: Lights when script execution is in process.

(d) Orange **Link Up** LED: Lights when the PCI Express link is trained.

(e) Green **UPLD** (Upload): Lights when script is transferred from host machine to PE*Trainer*.

(f) **Manual Trigger** push-button: Disabled.

LEDs and Connectors on the PE*Trainer* ML Module

(g) Green **Connect** LED: Indicates that cabling is correct.

(h) **Tx Cable A**: Corresponds to connector A on probe data cable

(i) **Rx Cable C**: Corresponds to connector C on probe data cable

2.8 Rear Panel Description

From left to right, the UPAS rear panel contains the following components:

Figure 2.1 PE*Tracer* ML Rear Panel

USB Type B Host Machine Connector

This connector links the Analyzer to the host machine for the purpose of transmitting commands from the host machine to the Analyzer and uploading CATC Traces from the Analyzer's recording memory to the PE*Tracer* software for viewing and analysis or links the PE*Trainer* Exerciser to the host machine for the purpose of downloading scripts and controlling the behavior of the Exerciser.

RS-232 25-pin Data Input/Output Connector

This connector links a 25 pin RS-232 cable to an external Breakout Board. The Breakout Board allows signals to be sent from the Exerciser or Analyzer to an external device such as an oscilloscope or from an external device to the Exerciser or Analyzer for the purpose of triggering on an external input. You configure input/output signalling through the Recording Options dialog box. The Breakout Board use is described at the end of this chapter.

RS-232 40-pin Data Input/Output Connector

This connector links a 40 pin RS-232 cable to an external Breakout Board. The Breakout Board allows signals to be sent from the Analyzer to an external device such as an oscilloscope or from an external device to the Analyzer for the purpose of triggering on an external input. You configure input/output signalling through the Recording Options dialog box. Breakout Board use is described at the end of this chapter.

BNC Connectors Ext. In and Ext. Out

These BNC connectors allow the Analyzer to transmit or receive external signals. External signaling, in turn, can serve two functions:

- **Linking of Analyzers**: On dual Analyzer systems, the BNC connectors are used to create a loop for transmitting clocking information and commands between the Analyzers. This linking allows the two Analyzers to function as a single, logical Analyzer.
- **Triggering**: The **Ext. In** can receive a signal from another device and use that signal to trigger the end of the recording. Conversely, the **Ext. Out** connector can be used to send an output signal from the Analyzer to another device.

The **Ext. In** and **Ext. Out** connectors have the same function as the 25 pin RS-232 connector - i.e., they channel input and output signals but do not support the use of a Breakout Board.

The BNC connectors are not used for the PE*Trainer* Exerciser.

Wide-range AC Connector Module

- Power socket
- Power on/off switch
- Enclosed 5x20 mm 2.0A 250 V fast acting glass fuse

Warning! For continued protection against fire, replace fuse only with the type and rating specified above.

2.9 Specifications for PE*Tracer* ML/PE*Trainer* ML

The following specifications describe a combined PE*Tracer* ML *or* PE*Trainer* ML and Universal Protocol Analyzer System (UPAS).

Package

Dimensions	**UPAS 10000**: 12.2 x 12.2 x 3.5 inches (31.1 x 31.1 x 8.9 cm) **PE*Tracer* ML Plug-in:** 9.3 x 6.7 x 1.3 inches (23.6 x 17.0 x 3.2 cm) **PE*Trainer* ML Plug-in**: 9.3 x 6.7 x 1.3 inches (23.6 x 17.0 x 3.2 cm)
Connectors	**PE*Tracer* ML:** 2 Probe Data (HSSDC2 receptacle) **PE*Trainer* ML:** 2 Probe Data (SFF-8470 Multi-lane Copper Connector) UPAS AC power connection External trigger connection (DB-25, TRIG IN/OUT, BNC) host machine connection (USB2.0) Breakout Board (type D)
Weight	**UPAS 10000**: 9.5 lbs (4.3 kg) **PE*Tracer* ML Plug-in**: 1.7 lb (0.77 kg) **PE*Trainer* ML Plug-in**: 1.7 lb (0.77 kg)

Power Requirements

90 to 254 VAC, 47 to 63 Hz (universal input), 100 W maximum

Environmental Conditions

Operating Temperature	0 to 40 °C (32 to 104°F)
Storage Range	-20 to 80 °C (-4 to 176°F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Switches

Power	On/Off
Manual Trigger	When pressed forces a trigger event

Indicators (LEDs)

UPAS:

Power (PWR)	Illuminated when Analyzer is powered on
Status (STATUS)	Illuminated during Power-On Self Test (POST) and when the Analyzer detects valid on the PCI Express link
Recording (REC)	Illuminated when the Analyzer is actively recording traffic data
Triggered (TRG)	Illuminated when the Analyzer has a valid trigger condition
Uploading (UPLD)	Illuminated when the Analyzer is uploading its recording memory to the host machine for displaying the CATC Trace and during the memory-testing step of the POST

PE*Tracer* ML Plug-in:

Activity	Illuminated when Analyzer detects valid traffic for the two dual-simplex connections of the PCI Express Link

Probing Characteristics

Connection

PE*Tracer* ML: PCI Express Slot Interposer card
Mid-Bus probe
(for more information about mid-bus probes, refer to the *PETracer Mid-Bus Probe™ Installation Guide*)

PE*Trainer* ML: Slot Interposer card (Device emulation Interposer)
Host Emulation Test fixture (Host emulation)

PE*Tracer* Recording Memory Size

2 GB for CATC Trace capture, timing, and control information.

PE*Tracer* Basic Trigger Events

Link Conditions	Link Alive, Electrical Idle Link Condition, TS1 Ordered Set, TS2 Ordered Set, Skip Ordered Set, Electrical Idle Ordered Set, FTS Ordered Set, Compliance Pattern Ordered Set, Comma, DLLP, TLP
TLP Headers	**TLP Type**: Mem, I/O, Cfg, Msg, Cpl, Any Traffic Class number
DLLP Messages	Ack/Nak, InitFC1, InitFC2, UpdateFC, PM, Vendor
Payload	Customizable Payload, Mask, Match
Errors	DLLP CRC, TLP LCRC, TLP ECRC, Delimiter, EDB (End-of-Bad Packet), Disparity, Symbol, Idle data, Skip late, Ordered Set Format

Breakout Board (BOB)

Filter in/out capabilities

PE*Tracer* Reporting and Statistics

Transport Layer Packet (TLP)	Memory Read 32-bit, Memory Read 64-bit, Memory Write 32-bit, Memory Write 64-bit, I/O Read Request, I/O Write Request, Configuration Read Type 0, Configuration Write Type 0, Configuration Read Type 1, Configuration Write Type 1, Message, Message with Data, Completion, Completion with Data, Completion for Locked Memory Read, Completion for Locked Memory Read with Data, Requesters, Completers, Traffic Class Number, Virtual Channel ID Number
Data Link Layer Packet (DLLP)	Ack, Nak, PM, Vendor, InitFC1-P, InitFC1-NP, Init-FC1-Cpl, Update FC-P, Update FC-NP, Update FC-Cpl, InitFC2-P, InitFC2-NP, Init-FC2-Cpl, Flow Control
Link Transactions	Implicit, Explicit, Incomplete
Split Transaction	Successful Completion, Unsupported Request, Cfg Request Retry, Completer Abort, Incomplete
Error Reports	Bad ECRCs, Bad LCRCs, Invalid 10b code, Running Disparity Error, End of Bad Packet, Delimiter Error, TS Data Error, Ordered Set Format Error, Idle Error

Host Machine Software Requirements

Operating System	Windows® XP and Vista

PE*Trainer* Script Memory Size

2 GB

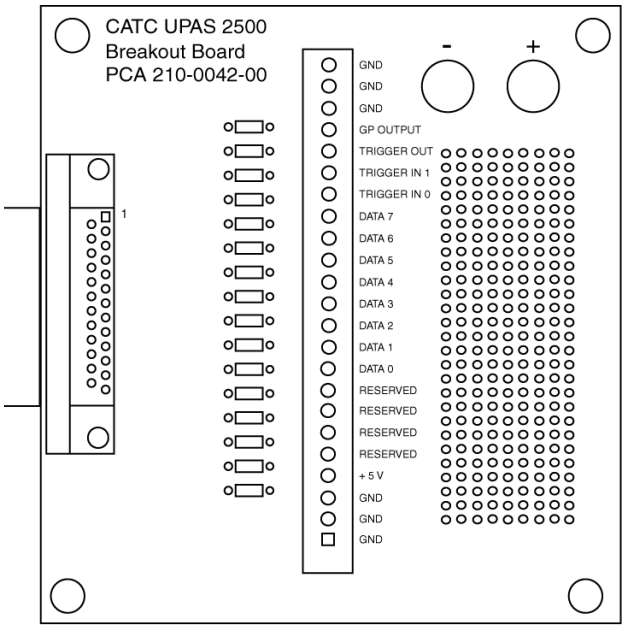
PE*Trainer* Wait Conditions

Time-Based Wait

Wait for User Input

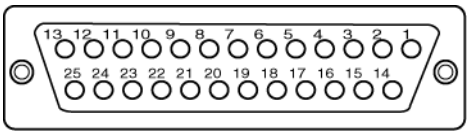
2.10 External Interface Breakout Board

With each Analyzer, Teledyne LeCroy includes an External Interface Breakout Board for accessing several potentially useful standard, LV TTL output and input signals. The Breakout Board also offers a simple way to connect logic Analyzers or other tools to the PE*Tracer* ML Analyzer unit. Six ground pins and one 5-volt pin are provided.



The Breakout Board connects via a cable to the **Data In/Out** connector located on the rear of the Analyzer unit. Each signaling pin is isolated by a 100 Ω series resistor and a buffer inside the Analyzer unit.

Data In/Out Connector (on cable)



Pin-Outs for the Data In/Out Connector

The following table lists the pin-out and signal descriptions for the **Data In/Out** connector on a cable that connects to the Breakout Board.

Data In/Out Connector – Pin-Out

Pin	Signal Name	Signal Description
1	RSV	Reserved
2	GND	Ground
3	GP OUT	General Purpose Output
4	TRG IN 1	Trigger In 1
5	GND	Ground
6	DATA 6	Data 6
7	DATA 4	Data 4
8	DATA 3	Data 3
9	DATA 1	Data 1
10	GND	Ground
11	RSV	Reserved
12	RSV	Reserved
13	+5V	+5 Volts, 250 mA DC Source
14	RSV	Reserved
15	GND	Ground
16	TRG OUT	Trigger Out
17	TRG IN 0	Trigger In 0
18	DATA 7	Data 7
19	DATA 5	Data 5
20	GND	Ground
21	DATA 2	Data 2
22	DATA 0	Data 0
23	GND	Ground
24	RSV	Reserved
25	RSV	Reserved

Note: (*) Pins 4 and 17 have the same function: they allow external signals to be used to cause triggering or recording. Pins 3 and 16 are used to transmit output signals. Pins 6, 7, 8, 9, 18, 19, 21, and 22 (data pins) are used to define data patterns for external input signals.

Note: All models of PE*Tracer* only support Data 0 - Data 3.

Prototype Rework Area

The Breakout Board contains a prototype rework area for making custom circuits for rapid development. The area consists of plated-through holes, 20 columns wide by 27 rows long. The top row of holes is connected to GND and the bottom row is connected to +5V. The remaining holes are not connected. Use the rework area to insert custom components and wire-wrap their respective signal, power, and ground pins.

Breakout Board Input and Output Signals

A Breakout Board can be used to channel input signals into the Analyzer in order to cause triggering. A Breakout Board can also be used to channel signals from the Analyzer to an external source.

Drive strength for all outputs is about 30 mA high (@2 V) and 60 mA low (@0.5 V). Inputs can handle 0 V to 5.5 V. Inputs above 2 V are detected as logic high; inputs below 0.8 V are detected as logic low.

The Breakout Board connects via a cable to the Data In/Out connector on the rear of the UPAS.

External Recordable Signals

Breakout Board Data 0-3: These pins let you define a 4-bit Data Pattern that can be recorded in a CATC Trace file.

External Input Triggers

You can use either an external input signal or the Trigger button on the front of the UPAS to cause triggering. The following descriptions show what pins or buttons to use:

Breakout Board Data 3 - Data 0: Triggers on a 4-bit input pattern.

Breakout Board Trigger In 0: Selectable Edge triggered inputs. Triggers on any edge it detects.

Breakout Board Trigger In 1: Selectable Edge triggered inputs. Triggers on any edge it detects.

BNC Trigger (EXT IN): Selectable Edge triggered inputs. Triggers on any edge it detects. Located on the back of the chassis.

Push Button Trigger: The Trigger button on the front of the UPAS can be pressed to manually cause a trigger.

External Outputs

The Analyzer can be configured to send an external signal anytime a trigger and/or event occurs. The following descriptions show the behavior of these output signals:

Breakout Board Trigger Out: Changes from low to high when Analyzer triggers (one time per recording only)

Breakout Board G.P. Output: Programmable waveform (low or high pulse, toggle). Each event can be programmed to enable this external signal.

BNC Output (EXT OUT): Same as Breakout Board G.P. Output. Located on the back of the chassis.

Setting Recording Options to Support External Input/Output Signaling

After a Breakout Board has been connected to a UPAS, the Analyzer must be configured for external or internal input signaling.

Chapter 3: Installation

PE*Tracer*™ ML™ or PE*Trainer*™ ML™ is a factory-installed hardware module that is sold as part of the Universal Protocol Analyzer System™ 10000 (UPAS™ 10K).

The UPAS 10K, UPAS 100K, modules, and associated software are easily installed. You can begin making PCI Express™ recordings or begin traffic generation after following the steps in this chapter.

3.1 Installing the PE*Tracer* Software

PE*Tracer* software operates all of Teledyne LeCroy's PCI Express protocol Analyzer and Exerciser products:

The PE*Tracer* software is installed on a Microsoft® Windows®-based host machine and serves as the interface for the Exerciser and/or Analyzer. When an Exerciser is attached, traffic generation features are enabled.

After the Analyzer or Exerciser has been recognized as a USB device, install the PE*Tracer* software on the host machine:

Step 1 Insert the CD into the CD ROM drive of the host machine that controls the Analyzer or Exerciser. The installation window opens and displays links to the PE*Tracer* software, user manuals, a readme file, and Acrobat Reader.

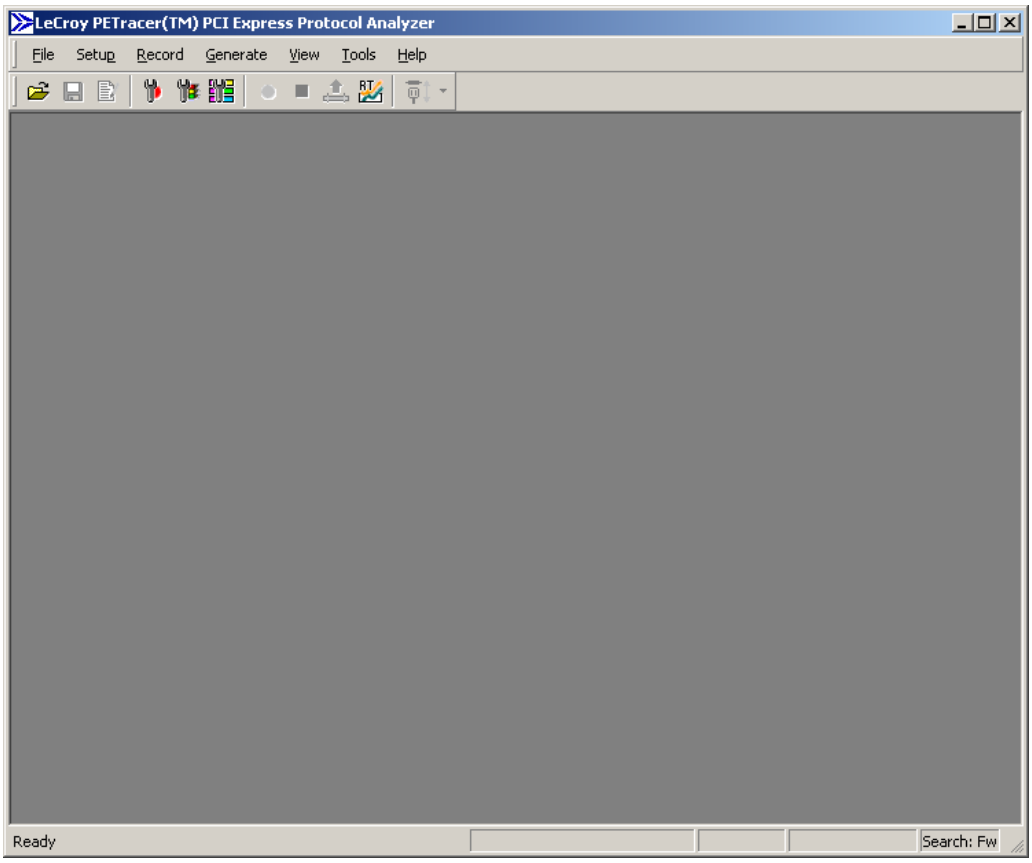
Step 2 Select **Install Software** and follow the on-screen instructions.

The PE*Tracer* software installs automatically on the host machine's hard disk. During installation, all necessary USB drivers are loaded automatically. Drivers included in the installation are:

- **ctcupa10.sys**: UPAS 10K driver
- **petrcrml.sys**: PE*Tracer* ML driver
- **petranx4.sys**: PE*Trainer* ML driver

Step 3 To start the application, launch the PE*Tracer* program from the Start menu:
Start > Programs > LeCroy > PETracer > LeCroy PETracer

The PE*Tracer* program opens:



Note: The software may be used with or without the Exerciser or Analyzer. When used without an Exerciser or Analyzer attached to the computer, the program functions as a Trace Viewer to view, analyze, and print captured traffic.

3.2 Setting Up a PE*Tracer* Analyzer

Step 1 Remove the Analyzer/UPAS from its shipping container. The module is already installed in the UPAS.

Step 2 Connect the Analyzer unit to a 100-volt to 240-volt, 50 Hz to 60 Hz, 120 W power outlet using the provided power cord.

Note: The Analyzer is capable of supporting supply voltages between 100 volts and 240 volts, 50 Hz or 60 Hz, thus supporting all known supply voltages around the world.

Step 3 Connect the USB cable between the USB port on the back of the Analyzer and a USB port on the host machine.

Step 4 Turn on the power switch on the rear of the UPAS.

Note: At power-on, the Analyzer initializes itself in approximately five seconds and performs an exhaustive self-diagnostic that lasts about fifteen seconds. The Status LED of the UPAS base unit turns red on power up/initialization. The LED remains on approximately 20 seconds while the Analyzer performs self-diagnostic testing. If the diagnostics fail, the Status LED blinks red, indicating a hardware failure. If this occurs, call Teledyne LeCroy Customer Support for assistance.

Step 5 Follow on-screen Plug-and-Play instructions for the automatic installation of the Analyzer as a USB device on the host machine (the required USB files are included on the CD). Step through the Windows® hardware wizard. If the wizard prompts you for driver information, point it to the CD which should be in your disk drive.

The host machine's operating system detects the Analyzer and begins to install the USB driver.

3.3 Setting Up a PE*Trainer* Exerciser

Step 1 Remove the Exerciser and UPAS from its shipping container. The PE*Tracer* ML module is already installed in the UPAS.

Step 2 Connect the Exerciser to a 100-volt to 240-volt, 50 Hz to 60 Hz, 120 W power outlet using the provided power cord.

Note: The Exerciser is capable of supporting supply voltages between 100-volt and 240-volt, 50 Hz or 60 Hz, thus supporting all known supply voltages around the world.

Step 3 Connect the USB cable between the USB port on the back of the UPAS and a USB port on the host machine.

Note: All hardware and cables should be setup prior to power-up. Install Device Emulator or Host Emulator as described in the previous sections. Also install any cables between the Emulator and PE*Trainer* ML Exerciser as described in the previous sections.

Step 4 Turn on the power switch on the rear of the UPAS.

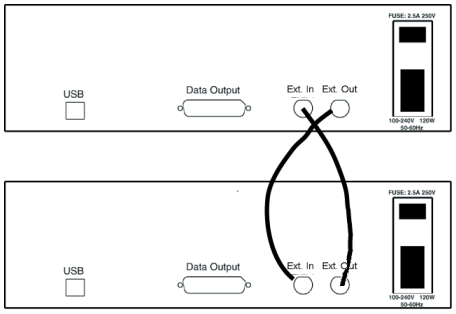
Note: At power-on, the Exerciser initializes itself in approximately five seconds and performs an exhaustive self-diagnostic that lasts about fifteen seconds. The Status LED of the UPAS base unit turns red on power up/initialization. The LED remains on approximately 20 seconds while the Exerciser performs self-diagnostic testing. If the diagnostics fail, the Status LED blinks red, indicating a hardware failure. If this occurs, call Teledyne LeCroy Customer Support for assistance.

Step 5 Follow on-screen Plug-and-Play instructions for the automatic installation of the Exerciser as a USB device on the host machine (the required USB files are included on the CD). Step through the Windows® hardware wizard. If the wizard prompts you for driver information, point it to the CD which should be in your disk drive.

The host machine's operating system detects the Exerciser and begins to install the USB driver.

3.4 Installing a Dual Analyzer System

If you have purchased a dual Analyzer system, you must physically link the Analyzers together. You link the Analyzers via their BNC connectors on the back of the two UPASs. You connect the **Ext. Out** connector of one Analyzer to the **Ext. In** connector on the other Analyzer, and *vice versa*, thereby creating a loop. The Analyzers use this loop to transmit clocking information and commands from one Analyzer to the other. From a user point of view, the interaction between the two Analyzers is transparent and requires no user intervention other than the physical linking of the Analyzers.

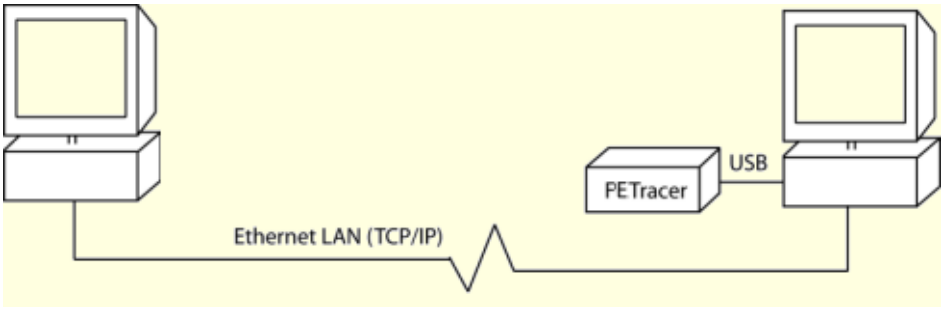


3.5 Networking an Analyzer

PE*Tracer*™ has a networking capability that allows users to run an Analyzer remotely over an IP-based LAN. Using the Network browse dialog, you can locate and connect to other host machines on the LAN, which, in turn, are connected to Analyzers. Through this connection, you can remotely control an Analyzer.

Setup for IP LAN Use

In order to connect to a remote Analyzer, the Analyzer must be attached to a host machine that is on the LAN. This host machine must have PE*Tracer* installed.

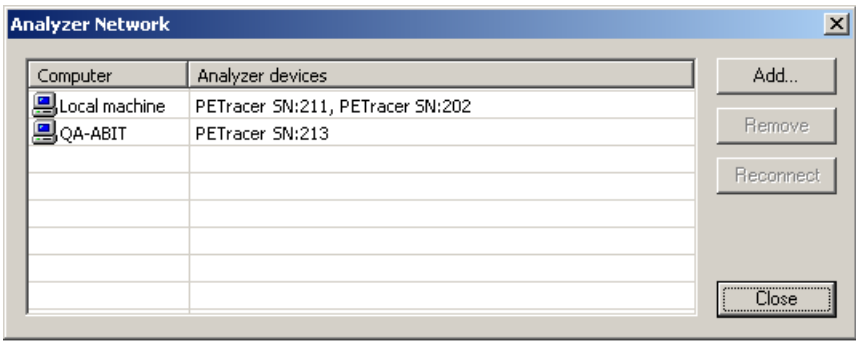


3.6 Browsing to a Networked Analyzer

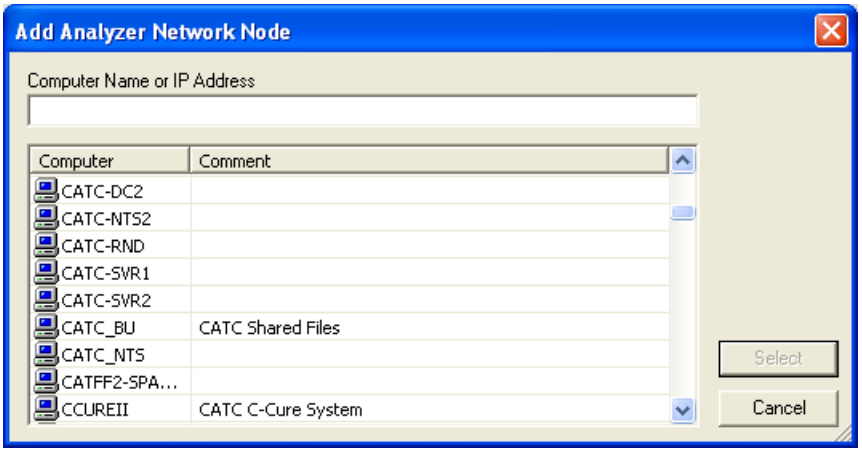
For the PE*Tracer* ML and the PE*Trainer* ML, you can browse to a networked analyzer.

To browse to a networked Analyzer:

Step 1 From the menu, select **Setup > Analyzer Network**. The Analyzer Network dialog box opens. Locally connected Analyzers (connected via USB) display in the list. The list may also show host machines and Analyzers identified in previous sessions.



Step 2 If the desired host machine and Analyzer are not present in the list, click **Add**. The Add Analyzer dialog box opens.



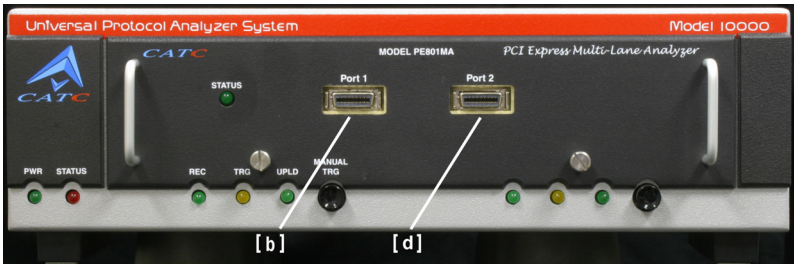
Step 3 Browse to the host machine that has the Analyzer(s), then click **Select**. The selected host machine and its Analyzer appear in the Analyzer Network browse dialog.

Note: The Analyzer must be turned on before it appears in the list.

Step 4 Remove host machines and Analyzers you do not intend to use in the current recording session by selecting them from the list and clicking **Remove**.

The PE*Tracer* software establishes a connection to the selected Analyzer.

3.7 Connecting the PE*Tracer* ML Analyzer to the Device Under Test

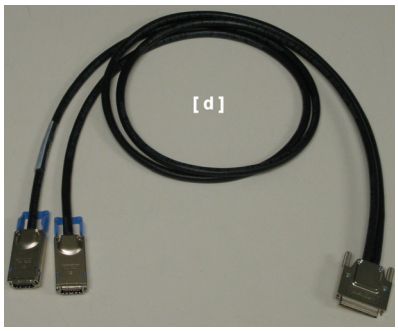


PE*Tracer* ML Components

(a) PE*Tracer* ML Probe Data connector

(b) PE*Tracer* ML Probe Data connector

(c) Probe Data cable: Cable with four connectors. The four-connector cable supports x8, x4, x2, and x1 links. The small connectors connect to the front of the Analyzer(s). The large connector at the other end connects to the Interposer.



(d) Probe Data cable: Cable with two connectors. The two-connector cable supports x4, x2, and x1 links. The small connectors connect to the front of the Analyzer(s). The large connector at the other end connects to the Interposer.

(e) PE*Tracer* ML Slot Interposer Probe: The probe has two connectors: a gold male connector that fits into a standard PCI Express slot, and a black female connector that accommodates a PCI Express device. There are two versions of the probe, an x8 probe and a x4 probe. The gold male adapter on the x4 probe is half the length of the x8.

Black Female Connector for a Device

PE*Tracer* Cable Connector To Analyzer

Edge Connector (to Motherboard)

Installing the Interposer between the Devices Under Test (DUTs)

To install the Interposer between the Devices Under Test (DUT), perform the following step:

Step 1 If not already powered off, power off the UPAS 10000 Analyzer and the DUTs.

Step 2 Insert the gold male connector on the Interposer probe [e] into a PCI Express slot in the motherboard (or whatever board you are testing). The x4 Interposer is designed to fit tightly into any standard x4, x8, or x16 PCI Express slot. The x8 Interposer is designed to fit into any x8 or x16 PCI Express slot.

Step 3 Insert the PCI Express DUT into the black female device connector on the top edge of the Interposer. The Interposer's female device connector can accommodate any standard PCI Express device (x1, x4, x8, x16).

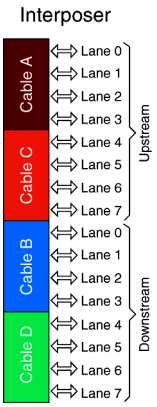
Step 4 The slot Interposer is shipped from Teledyne LeCroy with a metal face plate for attachment to a PC case. If you are working with a motherboard that is not in a PC case, you may prefer to remove the metal face plate so the Interposer can sit flat with the motherboard. To remove the face plate, unscrew the two screws that hold it onto the Interposer.

Connecting the Probe Data Cable

The next step is to connect the Probe Data cable. How you connect the cable depends on the width of your connection.

Probe Data Cable Description

The Probe Data cable consists of a single, large connector on one end and two or four smaller, 16 pin connectors on the other end. The large connector attaches to the Interposer, the smaller connectors attach to the front of the Analyzer.



The smaller connectors are labeled A, B, C, and D. Each transmits four physical lanes of traffic in one direction (shown in the illustration on the right). This means that to record bidirectional traffic you must use at least two of the small connectors: one to capture the transmit traffic and one to capture the receive traffic (with respect to one of the devices). The various configurations of connectors and link widths are shown in the table below.

Mid Bus Probe Configuration		System 1		System 2	
		Port 1	Port 2	Port 1	Port 2
1X, 2X, 4X	BD	A C	B D		
8X	BD	A	C	B	D
8X Lanes Reversed	BD	C	A	D	B

UD - Uni-Directional BD - Bi-Directional					
Interposer Configuration		System 1		System 2	
		Port 1	Port 2	Port 1	Port 2
1X, 2X, 4X	UD	A B			
	BD	A	B		
8X	UD	A B	C D		
	BD	A	C	B	D
8X Lanes Reversed	UD	C D	A B		
	BD	C	A	D	B

Connecting the Interposer Data Cable
To connect the Interposer data cable:

Step 1 Insert the large connector of the Interposer data cable [c] or [d] into the Interposer's data connector located on the metal face plate of the Interposer [e].

Step 2 Connect the small connectors of the Interposer data cable [c] or [d] to the Analyzer probe data connectors [a] and, if needed, [b] on the front of the Analyzer. The number of connectors you use depends on the width and direction of the link you are attempting to monitor. See foregoing table to determine the appropriate number of connectors for your test.

Connect USB Cable and Power on the Analyzer and DUTs

Step 1 Connect the provided USB cable between the UPAS 10000 Analyzer and the host machine that runs the PE*Tracer* ML software.

Step 2 Power on the UPAS10000 Analyzer. The Analyzer's green power LED lights, and the red status LED turns on for approximately 20 seconds while the Analyzer performs self-diagnostics.

Step 3 After the Analyzer's red status LED turns off, power on the PCI Express system under test.

Step 4 Open the PE*Tracer* ML software on the host machine. The Analyzer is now ready for PCI Express traffic recording.

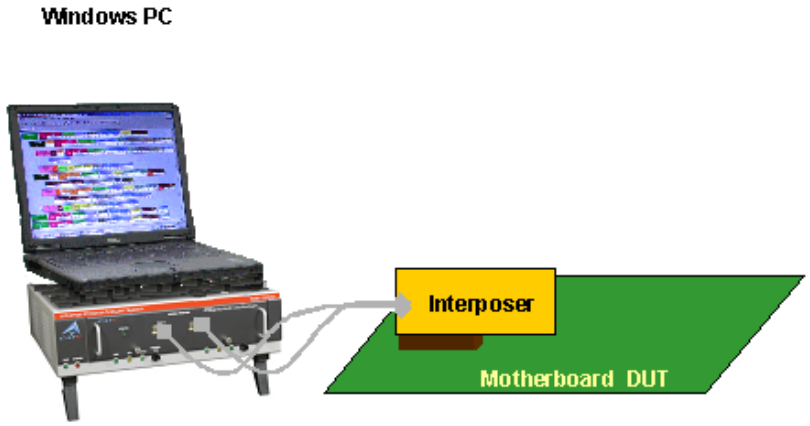
3.8 Connecting PE*Trainer* ML to the Device Under Test

PE*Trainer* ML can test both the host machine and device sides of a PCI Express link through the use of two types of adapter:

- **Motherboards and host controllers**: Using a **device emulation Interposer**. A device emulation Interposer is a PCI Express adapter card that fits into slotted PCI Express devices.
- **PCI Express add-on cards**: Using a **host emulation test fixture**. A host emulation test fixture is a box-like adapter with a slot for testing PCI Express cards.

Both of these test devices can be purchased from Teledyne LeCroy.

Device Emulator Interposer - Description



The Teledyne LeCroy Device emulation Interposer is an adapter that provides a way of connecting a PE*Trainer* ML Exerciser or PE*Tracer* ML Analyzer to a PCI Express motherboard. The Interposer has two connectors: a connector for a data cable and an edge connector for inserting the Interposer into a slotted DUT.

Host Emulation Test Fixture - Description

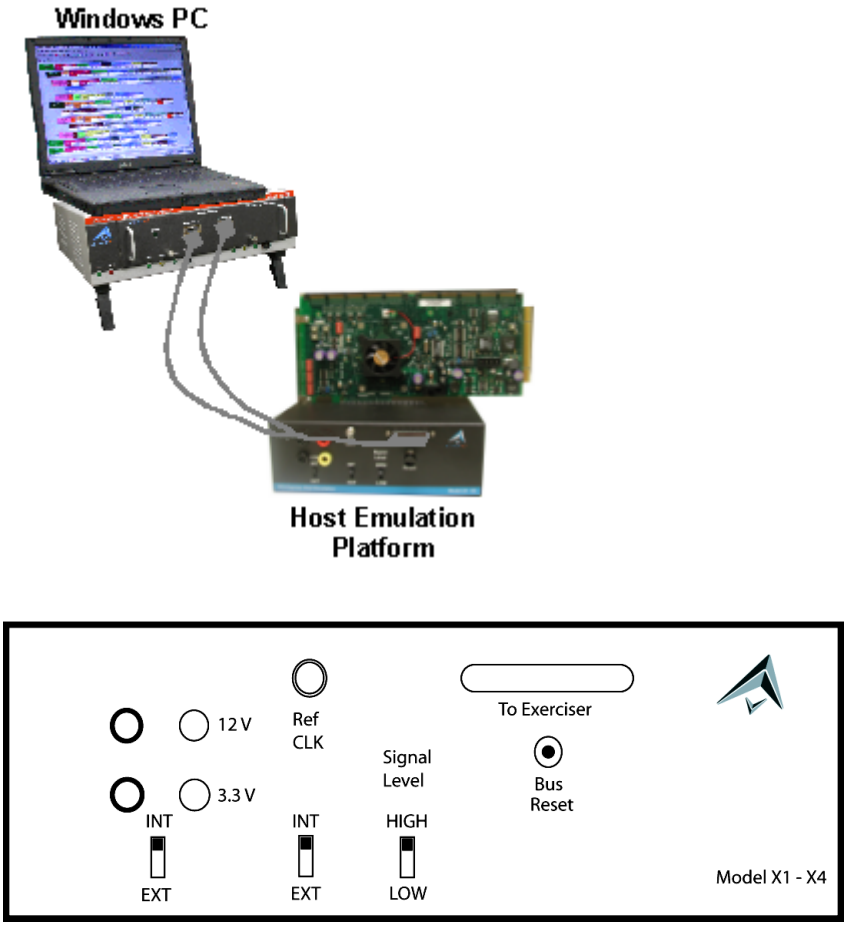


Figure 3.2 Host Emulation Test Fixture

Teledyne LeCroy Host Emulation Test Fixture: Hardware enclosure with a slot on top for accommodating a PCI Express card.

Data Cable Connector (**To Exerciser**): To connect to the PE*Trainer* ML and/or PE*Tracer* ML Analyzer.

Bus Reset button: Reset asserts PERST # for > 250 ms

Signal Level switch:

- Hi = PCI Express compliant (0.9V - 1.2V)
- Low = Testing (0.45V - 0.65V)

Power Switch: Selects between the internal power supply and the banana jacks on the front panel of the unit. When **External** power is selected, both 3.3V and 12V supplies must be provided by the user.

Reference Clock: Selects between the internal supplied 100 MHz reference or the user supplied reference via the **RefCLK** SMA connector.

Installing the Device Emulation Interposer

To install the Interposer into the DUT, perform the following steps.

Step 1 If not already powered off, power off the PE*Trainer*/UPAS 10K system and the DUT.

Step 2 Insert the edge connector on the Device Emulation Interposer into a PCI Express slot in the DUT. The Interposer is designed to fit tightly into any standard x4, x8, or x16 PCI Express slot.

Step 3 The slot Interposer is shipped from Teledyne LeCroy with a metal face plate for attachment to a PC case. If you are working with a motherboard that is not in a PC case, you may prefer to remove the metal face plate so the Interposer can sit flat with the motherboard. To remove the face plate, unscrew the two screws that hold it onto the Interposer.

Step 4 Attach probe data cable as described below in “Probe Data Cable Description” on page 32.

Installing the Host Emulation Test Fixture

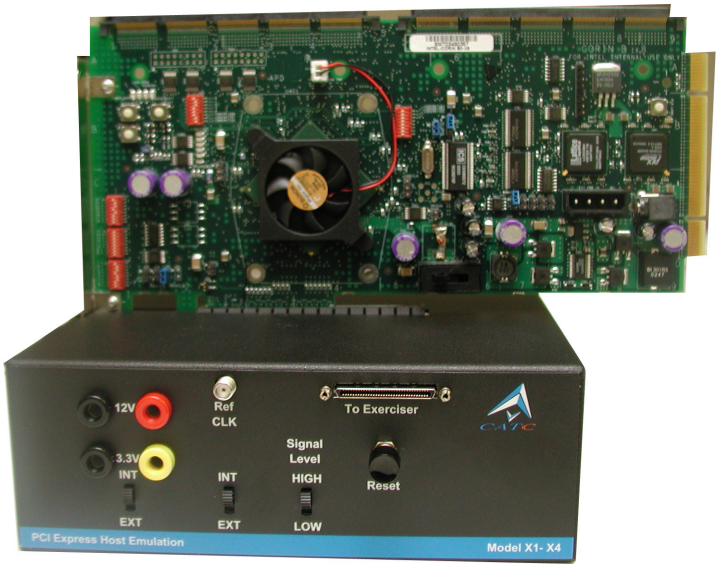


Figure 3.3 Host Emulation Test Fixture with DUT Card on Top

Step 1 If not already powered off, power off the PE*Trainer*/UPAS 10K system and the DUT.

Step 2 Insert the male edge connector of the DUT into the PCI Express slot on top of the Host Emulation Test Fixture.

Step 3 Attach probe data cable as described in the next section.

Probe Data Cable

The probe data cable is used to transfer x1 and x4 link PCI Express data to and from the Exerciser. The cable has a single wide connector on one end for connecting to the Interposer or the Host Emulation Test Fixture. At the cable's other end are four smaller connectors labeled A, B, C, and D. These connectors attach to ports on the front of a PE*Trainer* ML or PE*Tracer* ML system.

Each of the small connectors can only transmit in one direction. This means that at a minimum, two connectors are needed: one to transmit and one to receive.

Each connector transmits four physical lanes of unidirectional traffic. The lanes and port assignments are shown in the illustration below.

Cable Connectivity

Cable	Lane	Exerciser/Analyzer Port
Cable A	Lane 0	PETrainer ML **Tx-Cable A**
	Lane 1	
	Lane 2	
	Lane 3	
Cable C	Lane 0	PETrainer ML **Rx-Cable C**
	Lane 1	
	Lane 2	
	Lane 3	
Cable B	Lane 0	PETracer ML **Port 1**
	Lane 1	
	Lane 2	
	Lane 3	
Cable D	Lane 0	PETracer ML **Port 2**
	Lane 1	
	Lane 2	
	Lane 3	

Cable A, for example, transmits Lanes 0, 1, 2, and 3.

Attaching the Probe Data Cable to PE*Trainer* ML

Connector **A** on the probe data cable goes to port **Tx Cable A** and connector **C** goes to port **Rx Cable C** on the Exerciser.

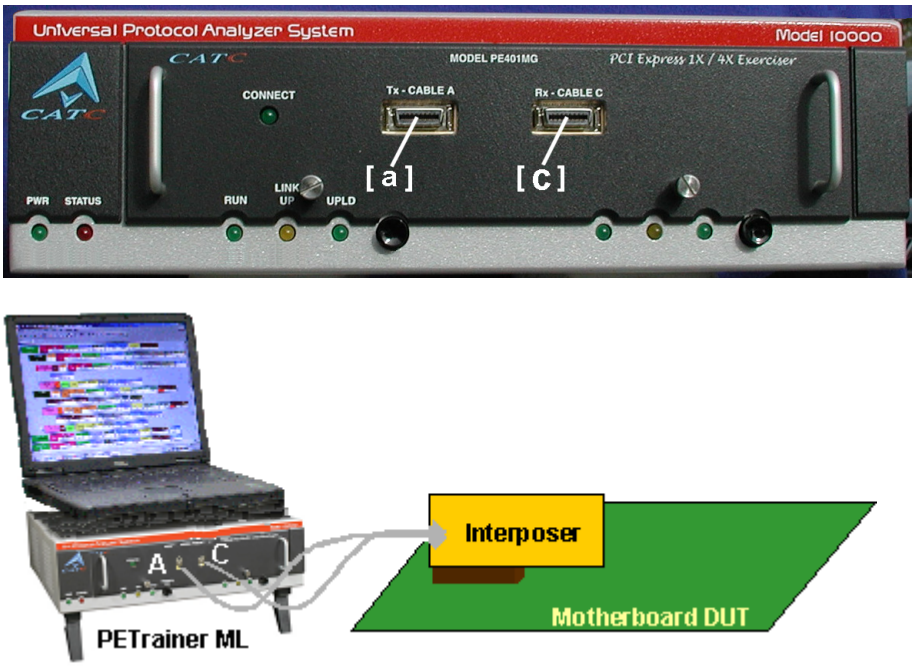


Figure 3.4 PE*Trainer* ML Front Panel showing where Connectors A and C Attach

Add a PE*Tracer* ML to Device Emulation Test Setup

To add a PE*Tracer* ML to the above setup:

Step 1 Attach connectors A and C to the Exerciser as described above.

Step 2 Attach connectors B to **Port 1** and connector D to **Port 2** on the PE*Tracer* ML Analyzer.

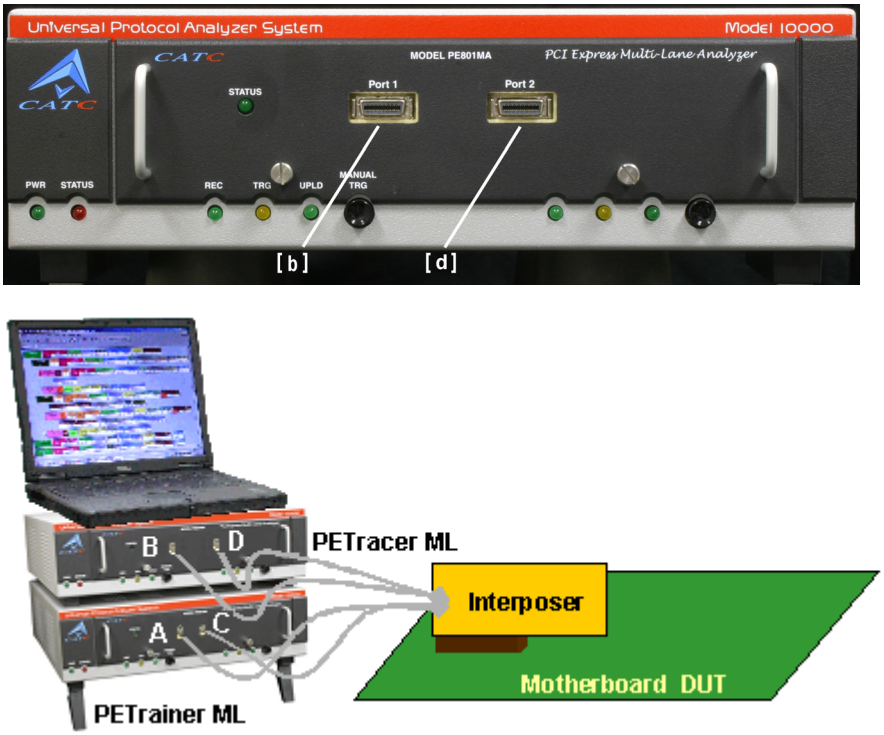


Figure 3.5 PE*Tracer* ML Front Panel showing where Connectors B and D Attach

Add a PE*Tracer* ML to Host Emulation Test Setup

To add a PE*Tracer* ML to a Host Emulation setup:

Step 1 Attach connectors A and C to the Exerciser as described above.

Step 2 Attach connectors D to **Port 1** and connector **D** to **Port 2** on the PE*Tracer* ML Analyzer.

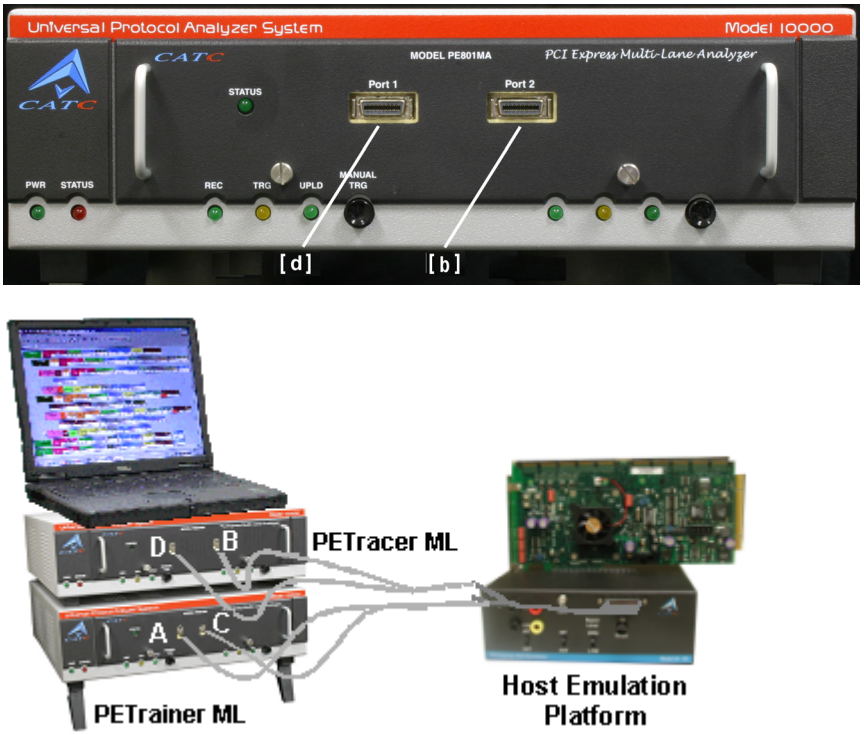


Figure 3.6 PE*Tracer* ML Front Panel showing where Connectors B and D Attach

Final Steps: Connect USB Cable and Power On the Exerciser and DUT

Step 1 Connect the provided USB cable between the UPAS 10K/PE*Trainer* ML and the host machine that runs the PE*Tracer* software.

Step 2 Power on the PCI Express system under test.

Step 3 Power on the UPAS 10K/Exerciser. The Exerciser's green power LED lights, and the red status LED turns on for approximately 20 seconds while the Exerciser performs self-diagnostics.

Section 2. PE*Tracer* Analyzer Software

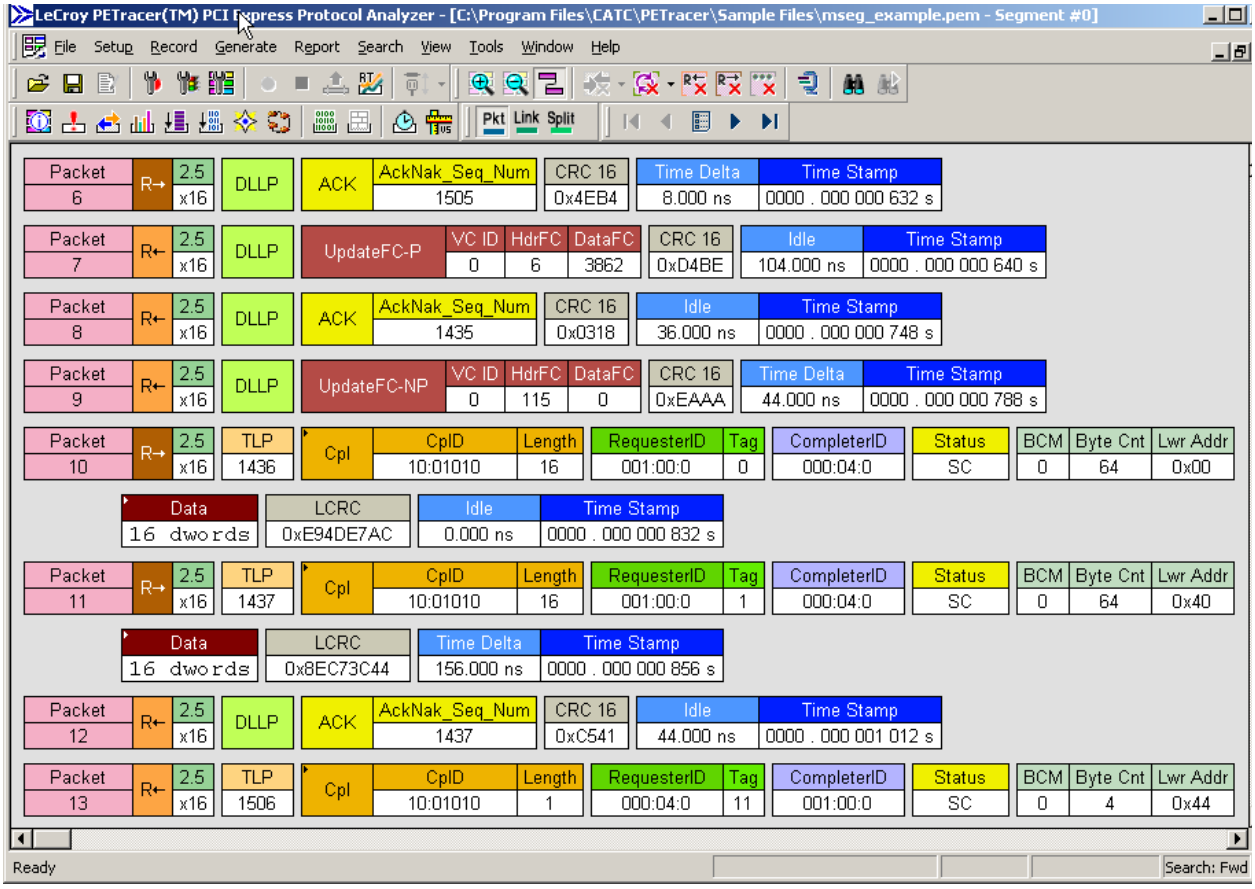
Chapter 4: Software Overview

4.1 The PE*Tracer* Software

The PE*Tracer*™ software administers Analyzer platforms and handles all CATC Trace analysis and display. When a PE*Trainer*™ Exerciser is present, the software generates PCI Express™ traffic. The core software is thus the same for all of Teledyne LeCroy's PCI Express products.

The software runs on a Windows®-based host machine that is attached to the Analyzer via an Ethernet connection or a USB 2.0 connection (USB 1.0 is also supported). PE*Tracer* software can be used without the Analyzer as a CATC Trace viewer for viewing, analyzing and printing CATC Traces.

The PE*Tracer* software operates in Microsoft® Windows® XP and Vista environments.


LeCroy PETracer(TM) PCI Express Protocol Analyzer - [C:\Program Files\CATC\PETracer\Sample Files\mseg_example.pem - Segment #0]
File Setup Record Generate Report Search View Tools Window Help
Pkt Link Split
Packet 6 R→ 2.5 x16 DLLP ACK AckNak_Seq_Num 1505 CRC 16 0x4EB4 Time Delta 8.000 ns Time Stamp 0000 . 000 000 632 s
Packet 7 R← 2.5 x16 DLLP UpdateFC-P VC ID 0 HdrFC 6 DataFC 3862 CRC 16 0xD4BE Idle 104.000 ns Time Stamp 0000 . 000 000 640 s
Packet 8 R← 2.5 x16 DLLP ACK AckNak_Seq_Num 1435 CRC 16 0x0318 Idle 36.000 ns Time Stamp 0000 . 000 000 748 s
Packet 9 R← 2.5 x16 DLLP UpdateFC-NP VC ID 0 HdrFC 115 DataFC 0 CRC 16 0xEAAA Time Delta 44.000 ns Time Stamp 0000 . 000 000 788 s
Packet 10 R→ 2.5 x16 TLP 1436 Cpl CplD 10:01010 Length 16 RequesterID 001:00:0 Tag 0 CompleterID 000:04:0 Status SC BCM 0 Byte Cnt 64 Lwr Addr 0x00
Data 16 dwords LCRC 0xE94DE7AC Idle 0.000 ns Time Stamp 0000 . 000 000 832 s
Packet 11 R→ 2.5 x16 TLP 1437 Cpl CplD 10:01010 Length 16 RequesterID 001:00:0 Tag 1 CompleterID 000:04:0 Status SC BCM 0 Byte Cnt 64 Lwr Addr 0x40
Data 16 dwords LCRC 0x8EC73C44 Time Delta 156.000 ns Time Stamp 0000 . 000 000 856 s
Packet 12 R← 2.5 x16 DLLP ACK AckNak_Seq_Num 1437 CRC 16 0xC541 Idle 44.000 ns Time Stamp 0000 . 000 001 012 s
Packet 13 R← 2.5 x16 TLP 1506 Cpl CplD 10:01010 Length 1 RequesterID 000:04:0 Tag 11 CompleterID 001:00:0 Status SC BCM 0 Byte Cnt 4 Lwr Addr 0x44
Ready
Search: Fwd

4.2 Application Layout

The PE*Tracer* application contains the following components:

Title bar: The title bar is at the top of the application window and displays the CATC Trace file name or generation script name.

Menu bar: The menu bar is located below the title bar, by default. The menu bar can be moved by clicking a blank area of the bar and then dragging the menu to a new position. It can be docked in another part of the application window or moved outside of the window to become a floating menu.

Toolbar: The toolbar is composed of buttons that represent the commonly used commands. The toolbar divides into smaller toolbars that can be moved and docked in a new position or made to float outside of the window.

Display area: The display area is the main part of the application window in which CATC Traces are displayed.

Status bar: The status bar is located at the bottom of the application window. The left end of the status bar displays descriptions of buttons and menu items when the mouse is positioned over them. The right end of the bar shows the search direction.

4.3 Using the Toolbar

You can use the PE*Tracer* application Toolbar as a shortcut to most of the operations supplied by the menus.

Opens a previously recorded CATC Trace file.

Edit as text.
Script Editor. Opens a text editor for editing traffic generation files (***.peg)**

Save As
Allows the open file to be saved with a new name.

Setup Recording Options
Opens the Recording Options dialog box.

Setup Display Options
Opens the Display Options dialog box.

Setup Generation Options
Opens the Generation Options dialog box.

Start Recording.

Real Time Statistics monitor
Opens a window that displays real-time information.

Stop Recording.

Disconnect/Connect Link.
Click once to break and momentarily later restore link. Open menu to select either Connect or Disconnect.

Repeat Upload.
Opens a dialog box that allows you to select a portion of memory to upload from memory, then causes the Analyzer to re-send the CATC Trace from the Analyzer buffer to the host machine.

Zoom in display.

Zoom out display.

Hide Training Sequence.

Hide SKIP and Update FC packets.

Hide Upstream recording/traffic.

Find
Opens a dialog box that allows you to select one or more items to find in the recording, then searches to that point.

View Packet Level data.

View Link Transaction Level data.

Wraps display information.

Hide Downstream traffic/recording.

Advanced Hiding Options
Opens a dialog box that allows you to select items to hide from view.

Compact View
Toggles compacting of training sequences to analyze CATC Trace data faster, or no compacting to display more data.

Find Next. Repeats last Find or Search action.

View Split Transaction Level data

File Information
Lists the conditions under which the recording was made.

Bus Utilization
Opens a window that graphically represents various information about the recording.

Error Report
Opens a window that lists all errors identified in the recording.

Link Tracker
Opens a window that displays symbol information per lane.

Traffic Summary
Opens a window that lists all events that occurred during the recording

Opens the Data Flow window.
Shows recorded data in a compressed tabular format.

Navigator. Shows/hides the Navigator bar - a utility that lets you easily navigate the CATC Trace.

LTSSM Flow Graph
Shows a state diagram of the LinkTraining and Status State machine.

Displays the Data/Payload window for the current packet.

Displays the Packet Header bar.
Opens a window that displays the header information in the current packet, as it would be viewed in the specification.

Opens the Timing and Bus Usage Calculations window.

Running Verification Scripts
Opens a dialog that allows you to select and run verification scripts.

Multi-Segment Toolbar

First Segment. Open first segment in the multisegment CATC Trace.

Index file. This button becomes active if a multisegment CATC Trace file is open and displays the index file for the recording.

Previous segment. Open previous segment in the multisegment CATC Trace.

Next Segment. Open next segment in multisegment CATC Trace.

Last segment. Open last segment in multisegment CATC Trace.

Traffic Generation Toolbar

These buttons appear on the status bar at the bottom of the screen if a PE*Trainer*™ Exerciser is attached. The buttons are explained below.

Start traffic generation

Resume traffic generation.

Stop traffic generation

Trainer Connect. Attempts to establish a G1 connection between PE*Trainer* and the DUT.

Trainer Disconnect. Breaks the connection between PE*Trainer* and the DUT.

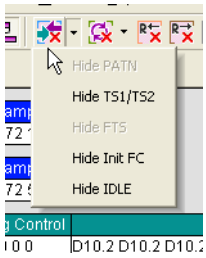
Read Address Space
Uploads information currently held in the Exerciser memory space.

Write Address Space
Downloads information into Exerciser memory.

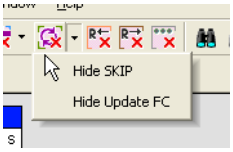
Toolbar Hide Buttons

The PE*Tracer* application toolbar has five buttons related to show/hide of CATC Trace file contents. The buttons allow you to quickly adjust the CATC Trace display to your needs.

Hide Training: Brings up a drop-down menu that lets you to hide all or a portion of the packets in the training portion of the CATC Trace.



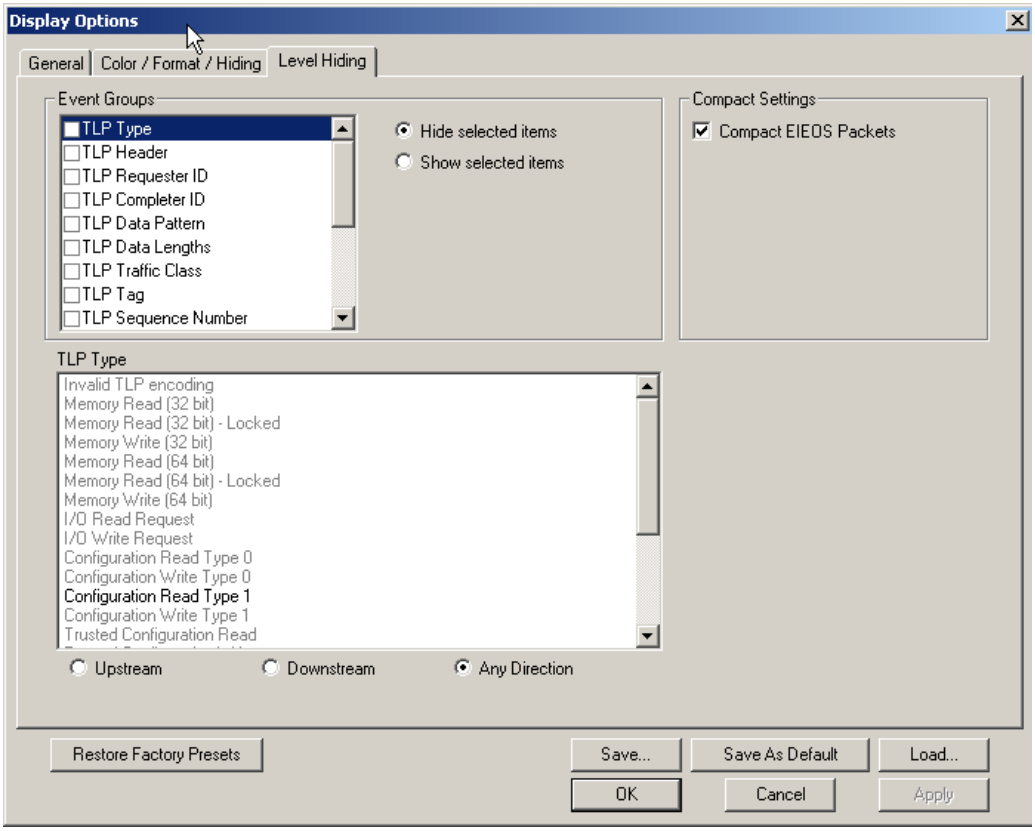
Hide SKIP and Update FC: Brings up a drop-down menu that lets you hide SKIP or Update FC packets in a CATC Trace.



Hide Upstream: Hide all traffic from endpoint devices to the root complex.

Hide Downstream: Hide all traffic from the root complex to endpoint devices.

Advanced Hiding Options: Brings up the Level Hiding pane of the Display Options window. Use this pane to tune the show/hide options within the CATC Trace display.



4.4 Using the Menus

The PE*Tracer* application main display includes the following set of pull-down menus:

File Menu

New PE*Trainer* Script	Creates a new Traffic Generation file.
Open	Opens a file.
Close	Closes the current file.
Save as	Saves all or a specified range of packets to a uniquely named file.
Convert Old Files	Convert CATC Trace files made in previous versions of PE*Tracer* to the new format for PE*Tracer* version 6.5x and higher.
Print	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup	Setup your current or new printer.
Edit Comment	Create or edit the comment field in a CATC Trace file.
Export >> to Text >> Packets to CSV Text >> to Generator File Format	Saves all or part of a CATC Trace to a text file or traffic generation file. This text file summarizes the traffic in the CATC Trace. Saves the CATC Trace to a text file in Comma Separated Value (CSV) format. Saves the CATC Trace to a generation file.
Exit	Exit the PE*Tracer* application.

Setup Menu

Display Options	Allows you to customize display options such as field colors, field formats and level hiding.
Recording Options	Allows you to customize control and setup features associated with recording, triggering, and filtering recorded events.
Generation Options	The Generation Options dialog box is used to set configuration settings in a traffic generation script (*.peg). This dialog provides a convenient alternative means of editing a traffic generation file.
Generation Macros	Opens a dialog for creating buttons on the status bar that can be used to run traffic generation macros.
Update Device	Opens a dialog box that lets you update the BusEngine™ and Firmware.
Calibrate Device	Opens a dialog box that lets you calibrate the BusEngine™ and Firmware.
Analyzer Network	Displays the list of host machines with connected analyzers or exercisers that you want to use for recording or traffic generation.
All Connected Devices	Opens a dialog box with a list of locally or remotely connected devices. Allows you to update the BusEngine, Firmware, and your licensing information.

Record Menu

Start	Causes the Analyzer to begin recording traffic.
Stop	Causes the Analyzer to stop recording traffic.
Reupload	Causes the Analyzer to re-send all, or selected portions, of the CATC Trace from the Analyzer buffer to the host machine.
Disconnect/Connect	Causes the Analyzer to momentarily break, and then establish the PCI Express link connection in both link directions.
Reset Link Configuration	Causes the Analyzer to reset the Serdes and thereby reset the Analyzers current link configuration. This command is needed when lane width or other lane settings are changed. Otherwise, the old link configuration is used and errors are generated in the CATC Trace.

Generate Menu

Connect	Initializes the link between PE*Trainer* and the device under test.
Disconnect	Disconnects the link between PE*Trainer* and the device under test.
Write Address Space	Reads PE*Trainer* internal memory used for address space mapping.
Read Address Space	Loads PE*Trainer* internal memory used for address space mapping.

Report Menu

Report Menu operations are only available when you are working with a CATC Trace file.

File Information	Displays information about the file contents and describes the conditions of the file's recording (Recording Options, hardware information, and so on).
Error Summary	Displays an error summary of the current CATC Trace file and allows you to go to a specific packet, and save the error file to a uniquely named file.
Traffic Summary	Details the number and types of packets that were transferred during the recording. You can hide, save, send, text, print, and view.
Bus Utilization	Opens a window with graphs of bus usage for the open CATC Trace.
Link Tracker	Opens a window for displaying a detailed chronological view of traffic. The window provides view and navigation options.
Data Flow	Opens the Data Flow Window, providing a tabular view of transactions and their payload.
Trace Navigator	Shows the Navigator bar for navigating a CATC Trace. Shows a snapshot of the recording and allows you to adjust the memory area for the view.
LTSSM Flow Graph	Shows a state diagram of bus activity. Also allows you to navigate through the LTSSM, based on the current recording.
Packet Header	Opens the Packet Header bar, showing the Packet Header information as it would be veiwed in the specification.
Packet Data/View Data	Opens the Data Window for the current packet, with the options: Hide, Save, Hexadecimal, ASCII, Decimal, Binary, MSB Format, LSB Format, Big Endian, and Little Endian. Format Line allows you to enter the number of bytes, words, or dwords per line.
Configuration Space	Presents a list of Configuration Spaces. Clicking an item displays the selected Configuration Space in a Configuration Table format.

Search Menu

Search Menu operations are only available when you are working with a CATC Trace file.

Go to Trigger	Repositions the display to show the first packet following the trigger event.
Go to Packet	Repositions the display to a specific packet, Link Transaction, or Split Transaction number.
Go to Time	Repositions the display to specific timestamp.
Go to Marker	Repositions the display to a previously marked packet, Link Transaction, or Split Transaction.
Go to	Allows searching for specific link events: TLP Type, DLLP Type, .Ordered Set, Link Event, Traffic Class, DLLP Virtual Channel, TLP Virtual Channel, Direction, Speed, Link Width, Requester ID, Completer ID, Data Lengths, Errors.
Find	Displays the Find dialog to allow searching for various events within a CATC Trace. You can search by Display Level: Packets, Link Transactions, Split Transactions. You can search packets by Event Group: TLP Type, TLP Header, TLP Requester ID, TLP Completer ID, TLP Data Pattern, TLP Data Lengths, TLP Tag, TLP Sequence Number, DLLP Type, DLLP Header, DLLP Virtual Channel, ACK/NAK Seq Number, Ordered Sets, Link Event, Direction, Errors. You can search link transactions by Event Group: TLP Type, Traffic Class, Virtual Channel, Direction, Requester ID, Completer ID, Status, Tag. You can search split transactions by Event Group: TLP Type, Traffic Class, Virtual Channel, Direction, Requester ID, Completer ID, Status, Tag. Find allows you to create complex searches based on numerous criteria.
Find Next	Repeats the previous Find or Search operation.
Search Direction	Allows you to specify a forward or backward search of a CATC Trace file.

View Menu

Toolbars>>	Displays available toolbars: Standard, Frequently Used, Analysis, and Transaction Level. Use Customize to display the Windows Customize window.
Script Editor	Displays the Script Editor (only appears if a **.peg** file is open).
Analyzer Network Chat Bar	Opens a chat window for communicating with persons working with networked Analyzers. This command requires that your host machine be attached to a LAN. The Chat window broadcasts messages to whatever host machines have been connected to via the Analyzer Network command (under Setup in the menu).
Status Bar	Switches display of the Status Bar on or off.
Real Time Statistics	Opens the Real Time Statistics monitor dialog and displays a real-time graph of link activity.
Zoom In	Zoom in increases the size of the displayed elements.
Zoom Out	Zoom out decreases the size of the displayed elements.
Wrap	Allows the display to wrap.
FC Credits	Toggles a display for tracking Flow Control Credit update and consumption on a PCI Express link.
FC Credits Setup	Allows you to customize the display for tracking Flow Control Credits.
Compact View	Toggles compacting of the Link Training sequence to analyze CATC Trace data faster or no compacting to display more data.
Packet Level	View the current recording at the Packet Level.
Link Transaction Level	View the current recording at the Link Transaction Level.
Split Transaction Level	View the current recording at the Split Transaction Level.

Tools Menu

Configuration Space Editor	Opens the Configuration Space Editor, allowing you to either create or modify the Configuration Space of the Exerciser.
Memory/IO Space Editor	Opens the Memory/IO Space Editor, allowing you to either create or modify memory spaces within the Exerciser.
TC to VC Mapping	Allows Traffic Classes to be mapped to Virtual Channels for purposes of simplifying navigation (for example, Search > Go to > TLP Virtual Channel) and changing the way the CATC Trace is displayed (for example, in Split Transactions).
Timing Calculations	Starts the mode-less calculator dialog for calculating various timing and bandwidth parameters in the recording file.
Run Verification Scripts	Presents a list of verification scripts, from which you can run a verification script.

Window Menu

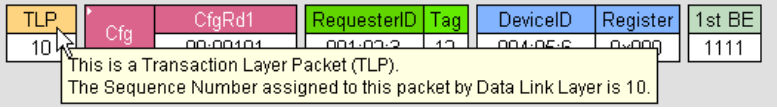
New Window	Opens a copy of the current CATC Trace window.
Cascade	Displays all open CATC Trace windows in an overlapping arrangement.
Tile	Displays all open CATC Trace windows as a series of strips across the display.
Arrange Icons	Arranges minimized CATC Trace windows at the bottom of the display.
Synchronize Traces	Synchronizes the CATC Trace View windows so that a move in one window repositions the other window of the same recording.

Help Menu

Help Topics	Accesses the PE*Tracer* application's Online Help.
Register Product Online	Register at the Teledyne LeCroy website registration page.
Check for Updates	Check whether a new software version is available. If so, you can download from the Teledyne LeCroy web site. You can select to **Check for updates at application startup**
Update License	Displays a dialog box for entering updated license information.
Display License Information	Opens an information box describing the current license information.
About	Displays version information about the attached Analyzer and its Firmware and BusEngine™.

4.5 Tool Tips

Tool tips provide details about fields within the CATC Trace. To see a tool tip, position your mouse pointer over a field within the CATC Trace.



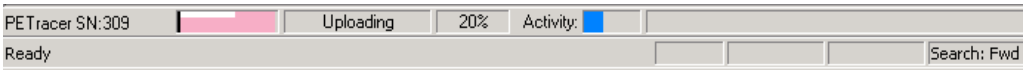
You can turn off this capability in the Display Options menu.

4.6 Keyboard Shortcuts

Keystrokes	Operation
Ctrl + N	New PE*Tracer* script
Ctrl+O	Open file
Ctrl+P	Print
Ctrl+S	Save file
Ctrl + R	Start Analyzer recording
Ctrl + T	Stop Analyzer recording
Ctrl+Home	Jump to first packet
Ctrl+End	Jump to last packet
Ctrl + G	Go to packet ...
Ctrl+F	Search forward
F3	Find next
F6	Next pane
Shift+F6	Previous pane
Ctrl+B	Search backward

4.7 Status Bar

The Status Bar is a gray bar that runs along the bottom of the application window.



From left to right:

PE*Tracer* SN:309: Analyzer Serial Number

Ready: Analyzer Status

Recording Progress Bar: The colored bar to the right of the serial number represents how much traffic has been recorded. The trigger point is indicated by the black line at the left side of the bar. In this example, the trigger occurred at the very beginning of the CATC Trace. If the trigger is set in the middle of the CATC Trace, the line is positioned in the middle of the bar. Additionally, the color of the bar is different on each side of the trigger point. For examples, see “Recording Progress Bar” on page 60. The white strip along the top edge of the color bar indicates how much traffic has been uploaded from the Analyzer buffer to the host machine.

Uploading and 20%: Indicates the Analyzer's recording status, what part of the recording process the Analyzer is now in. In this example, the Analyzer is in the upload stage and has completed 20% of the upload from the Analyzer to the host machine. See “Recording Status” on page 60 for details on other status messages.

Activity: The colored bar moves to indicate that the Analyzer is currently recording.

Search: Fwd: Indicates search direction. The direction can be toggled to **Search: Bwd** by double-clicking the search direction or by selecting **Search Direction** from the Search menu.

PE*Trainer* Status Bar

When a PE*Trainer* is attached, a Generation Status bar is displayed at the bottom of the screen. This bar has buttons to start and stop generation and to break and re-establish connection with the DUT. In addition, status info is displayed. See “Using the Toolbar” on page 45 for an explanation of these buttons.

From left to right:

Buttons: Start Generation, Stop Generation, Resume Generation, Start/Establish Connection, Break Connection, Write Address Space, Read Address Space

Status: Link State, InitFC State, Trainer Status

Link State Messages on PE*Trainer* Status Bar

When running PE*Trainer*, the status bar displays PE*Trainer* buttons and status information. The buttons allow you to start and stop traffic generation and to create and break links between PE*Trainer* and the DUT.

The Status bar has a section labeled **Link State** that displays messages about the Trainer link. The following list shows what types of messages can be displayed:

- Detect.Quiet
- Detect.Active
- Polling.Active
- Polling.Compliance
- Polling.Configuration
- Polling.Speed
- Configuration.Linkwidth.Start
- Configuration.Linkwidth.Accept
- Configuration.Lanenum.Wait
- Configuration.Lanenum.Accept
- Configuration.Complete
- Configuration.Idle
- L0
- L0s.Idle
- L0s.FTS
- L1
- L2
- Recovery.RcvrLock
- Recovery.RcvrCfg
- Recovery.Idle
- Loopback
- Hot Reset
- Disabled

InitFC State Messages on PE*Trainer* Status Bar

The Status bar has a section labeled **InitFC State** that displays messages about the Trainer InitFC State.

The following list shows what types of messages can be displayed:

- Not initialized
- Pending
- Complete

Recording Progress Bar

This indicator bar changes color to reflect the recording progress.

- Black vertical line is at the location of Trigger position.
- Black vertical line wiggles when Trigger Position is nearly reached.
- Field to right of Trigger Position changes color to indicate post-trigger activity.
- Upper half of progress indicator turns white when recording is complete.

Recording Status

The second segment from the left in the Status Bar indicates recording status.

During recording, this status flashes one of the following messages:

- Trigger?
- Triggered!
- Uploading

After recording stops, the message changes to

- Uploading data - x% done (where x equals the percent that has been uploaded.)

As uploading progresses, the percent increases to 100. You can abort this upload if you wish by pressing the **<escape>** button on your keyboard or clicking in the Tool Bar.

Recording Activity

The third segment displays recorded activity. Activity is indicated in blue:

Search Direction Indicator

The fourth segment in the status bar indicates search direction. The direction can be changed by selecting Search Direction from the Search menu.

4.8 Making a PCI Express Recording

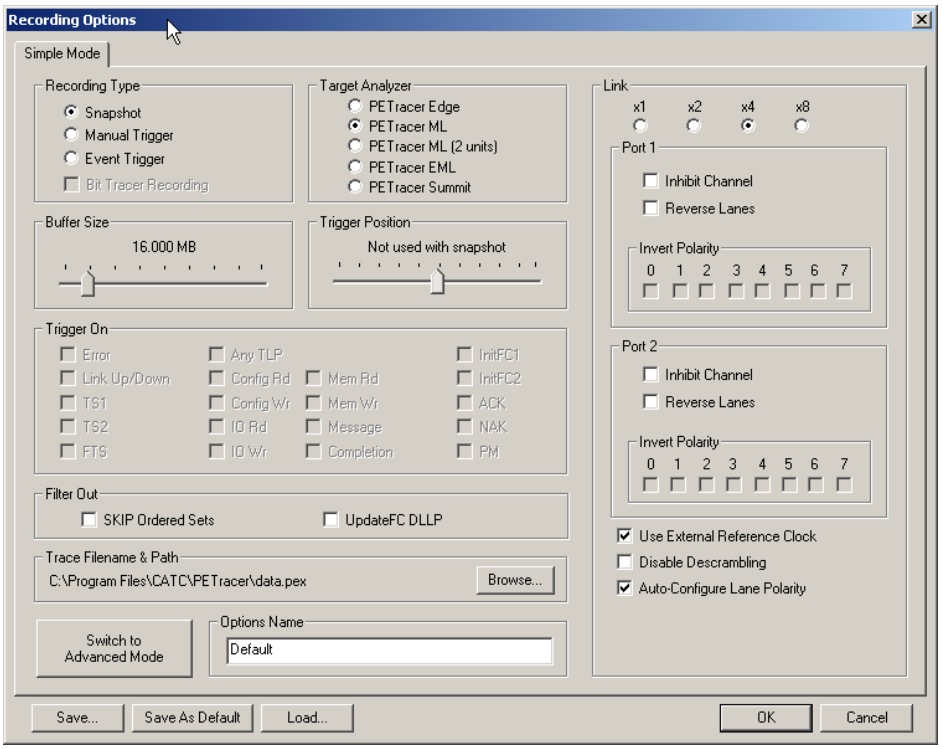
After connecting the Analyzer to the device(s), you must configure the Recording Options. Then you can test the Analyzer by creating a 16-MB snapshot recording.

To make this recording, follow these steps:

Step 1 From the **Setup** menu, select **Recording Options**.

Step 2 Select the **General** tab.

The following window displays the factory **PE*Tracer* ML** default settings in **Simple Mode**, such as Snapshot and 16-MB buffer size. For your first recording, you can leave these settings unchanged.



Step 3 In the **Link** section, specify the lane width of the PCI Express link to be analyzed. The rest of the settings in this section can be left at the factory defaults for most PCI Express systems.

Step 4 For multi-lane PCI Express links, the Analyzer needs to observe link training in order to record link traffic correctly. If link training (or re-training) is not easily controllable for the devices under test, the Analyzer includes the capability to force link training by disconnecting and reconnecting the PCI Express link.

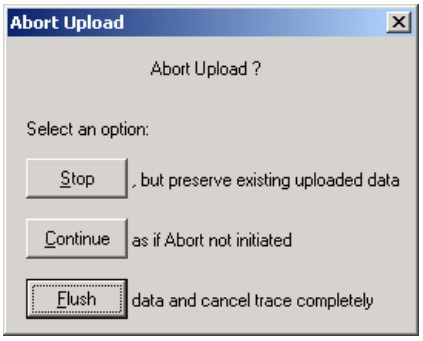
Clicking the **Connect/Disconnect** button disconnects the PCI Express link for one second in both directions, then re-establishes the link.
Note: For x1 PCI Express links, it is not necessary for the Analyzer to observe link training in order to record link traffic; this step may be skipped.

Step 5 Click **OK** at the bottom of the Recording Options dialog box to apply the Analyzer recording settings specified.

Step 6 Click the **Record** button.

Stopping a Recording

You can stop the recording process at any time by pressing the **Stop** button . This causes the Analyzer to stop the recording and upload the CATC Trace to the host machine. If you press the **Stop** button again, the Analyzer temporarily halts the upload process and opens the following dialog box:



This dialog presents options for stopping, continuing, or aborting the upload:

- **Stop**: Aborts further CATC Trace upload and displays whatever CATC Trace data that has already been uploaded.
- **Continue**: Resumes the upload. This command tells the Analyzer to finish uploading whatever CATC Trace data is still in its buffer.
- **Flush**: Flushes the CATC Trace without saving or displaying it.

If you allow the traffic data to be uploaded, it is automatically saved on the host machine's hard drive as a file named **data.pex** or the name you assign as the default filename in the recording options.

Saving a Recording

Step 1 To save a current recording for future reference, select **Save As** from the File menu.

Step 2 Give the recording a unique name, then save it to the appropriate directory.

4.9 Recording Multi-Segmented CATC Traces

If **Save as Multisegment trace** is enabled, PE*Tracer* divides the CATC Trace as it records it into segments and stores them on the host machine's hard drive.

This option is useful for very large recordings and for host machines with limited memory. In the latter case, multi-segmenting gives a host machine with limited memory a way to open recordings that are otherwise too large to open.

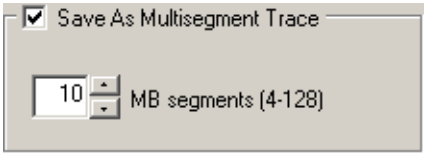
The only downside to multi-segmenting is that limits the scope of reports such as Traffic Summary, Bus Utilization, and Error Summary to each of the segments. You cannot perform summary statistics on the full recording.

The default segment size is 10 MB. Before attempting large recordings, it is recommended that you play with this number to see what value best suits your needs.

How to Create a Multisegment Recording

To create a Multisegment recording:

Step 1 Select **Setup > Recording Options** to open the Recording Options dialog at the General tab. Click **Switch to Advanced Mode**.



Step 2 Check the box marked **Save as Multisegment trace**.

Step 3 In the box marked MB Segments, enter a value of 4 to 128 MB.

What Gets Created

Multisegmenting produces an index file and segmented CATC Trace files. The default name of the index file is **data.pem**.

The index file and the segmented CATC Trace files are stored in a directory named after the index file. The directory is named **data_pem_files**. Below this directory additional, sequentially numbered sub-directories (up to 100,000) hold the segmented CATC Trace files. These sub-directories bear simple numerical names: 00000 to 00999. Each of these subdirectories can hold up to 100 sequentially numbered segment files. Collectively, the entire directory structure can hold up to 10 million files.

Example

If you create a 1010 MB recording using 10 MB segments, the following files and sub-directories are created:

`data.pem` (This is the index file.)

`data_pem_files\00000\segment_00000.pex`

`data_pem_files\00000\segment_00001.pex`

`...`

`data_pem_files\00000\segment_00099.pex`

`data_pem_files\00001\segment_00100.pex`

`data_pem_files\00001\segment_00101.pex`

Note: An additional index file is created called **segments.col**. This is an internal system file that users should not modify.

4.10 PE*Tracer* Files

The PE*Tracer* software creates and uses different kinds of files:

- **Trace Files**: Recorded traffic
- **Recording Options Files**: Configuration file that contains the various options selected in the Recording Options dialog box to configure the recording
- **Display Options Files**: Configuration file that contains the options selected in the Display Options dialog box to configure how traffic is displayed

CATC Trace Files

PE*Tracer* records PCI Express traffic into a CATC Trace file with the default name **data.pex** or any other that you specified in the Recording Options. This file is overwritten with new data each time PCI Express traffic is recorded. If recording an x8 link using two PE*Tracer* ML™ units, the CATC Trace files from the separate Analyzer units are merged into a single file with the default name **data.pex.**

When Multisegment CATC Traces are created, a special index file is also created called **<filename>.pem**. This index file provides a high level view of the CATC Trace segments created in the recording session.

If you want to save a CATC Trace, use the **File > Save As** function. This option allows you to save the current CATC Trace to a unique file name, thereby ensuring that it is not overwritten. This option also allows you to save a range of packets in a CATC Trace file.

You can pre-define the name of the recorded CATC Trace file using the Trace Filename and Path option in Recording Options.

Recording Options Files

Recording Options files are created when you set recording options. These files use the **.rec** extension and contain recording option information.

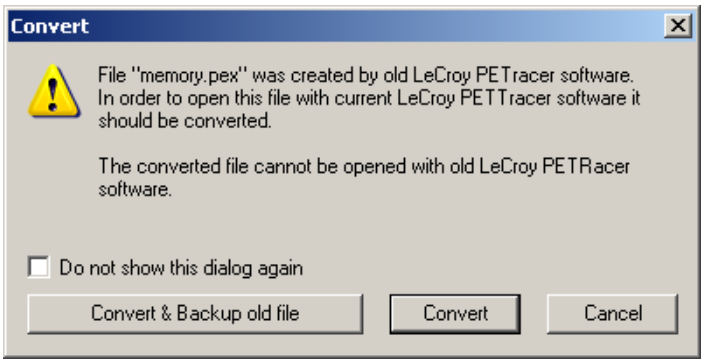
Display Options Files

Display Options files are created when you set display options. These files use the **.opt** extension and contain the display options information.

4.11 Opening CATC Trace Files

To open an existing CATC Trace file, click **File > Open** or .

If the file was made in a previous version of PE*Tracer*, the application presents the Convert dialog box:


Convert
File "memory.pex" was created by old LeCroy PETracer software.
In order to open this file with current LeCroy PETTracer software it should be converted.
The converted file cannot be opened with old LeCroy PETRacer software.
Do not show this dialog again
Convert & Backup old file
Convert
Cancel

You must convert CATC Trace files made in previous versions of PE*Tracer* for them to open in PE*Tracer* version 6.5x or higher. The converted file has all the information that was in the original file.

You can:

- **Convert & Backup old file**: Convert the file, open it in PE*Tracer* version 6.5x or higher, and save it with the original name. Save the original file with the same name plus the extension **.bak**.
- **Convert**: Convert the file, open it in PE*Tracer* version 6.5x or higher, and save it with the original name.

Note: After you convert a CATC Trace file, you cannot open the converted file in a previous PE*Tracer* version.

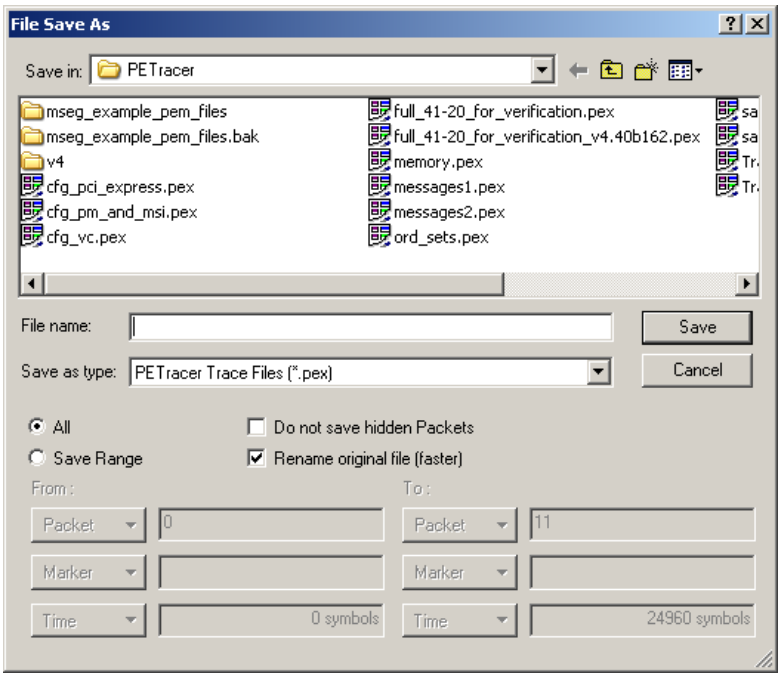
4.12 Saving CATC Trace Files

Using the Save As Function

When you record a CATC Trace file, the Analyzer software provides a pre-defined name to the CATC Trace file (**data.pex** or any other that you specified in the Recording Options). If you do consecutive recordings, each time the previous recording is overwritten. If you see a recording you want to analyze later, you need to give a unique name to the CATC Trace file, so it is not overwritten with the next recording.

Also, when you analyze a recorded CATC Trace file, you might be interested in preserving just a part of the PCI Express traffic that was recorded. If you save a portion of a CATC Trace file, it can get significantly smaller, allowing you to attach it to an e-mail.

To save a portion of a CATC Trace file or the whole file to a unique name, select **Save As** from the File menu.



If you want to give a unique name to the CATC Trace file, select the **All** option and keep **Rename original file** checked. This is the default setting for the dialog.

Saving a Portion of a CATC Trace

If you want to save a portion of a CATC Trace file, select **Save packet range**. Enter starting and ending packet numbers in the **From Packet** and **To Packet** fields. By default, it has the numbers of the first and the last packets in the file. The software is going to save all the packets in specified range to the new file, unless you have **Do not save hidden packets** checked. In this case it is going to save all packets in the range, EXCLUDING the currently hidden packets.

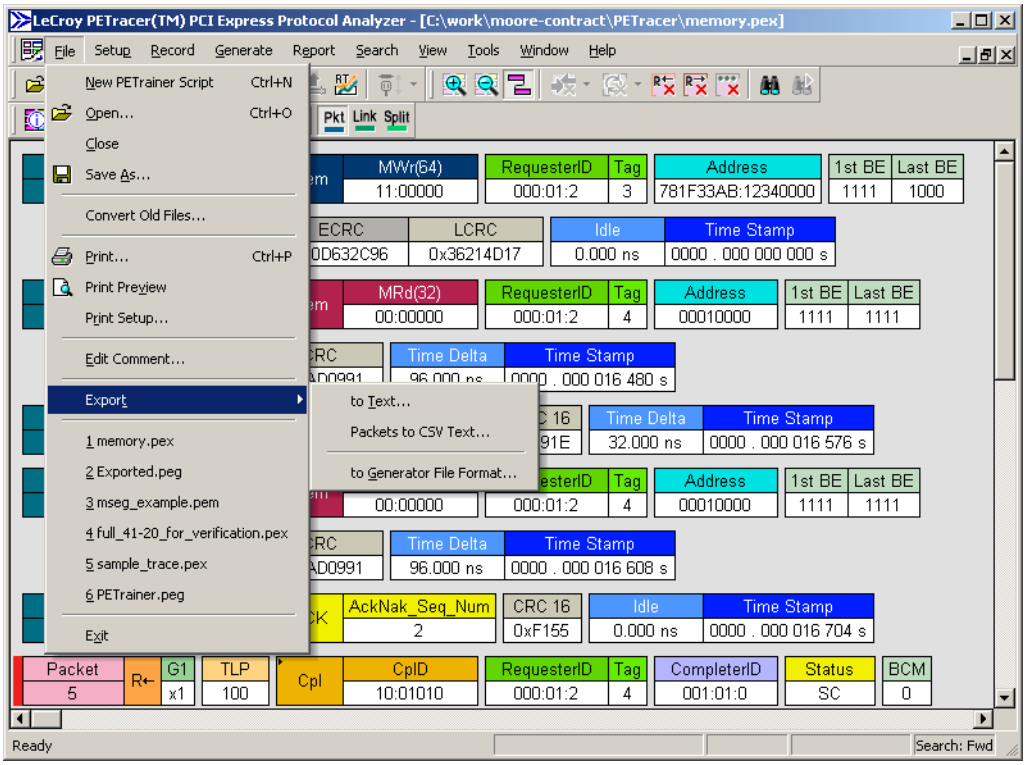
4.13 Exporting a CATC Trace File

By default, PE*Tracer* saves CATC Trace files in the **.pex** format. However, you can export a CATC Trace to a file in any of the following other formats:

- Text
- Comma Separated Value (CSV)
- Generator file format

Exporting to Generator file format is a simple way to create a script file from your CATC Trace.

To export a CATC Trace file, select **File > Export**:


LeCroy PETracer(TM) PCI Express Protocol Analyzer - [C:\work\moore-contract\PETracer\memory.pex]
File Setup Record Generate Report Search View Tools Window Help
New PETrainer Script Ctrl+N
Open... Ctrl+O
Close
Save As...
Convert Old Files...
Print... Ctrl+P
Print Preview
Print Setup...
Edit Comment...
Export
1 memory.pex
2 Exported.peg
3 mseg_example.pem
4 full_41-20_for_verification.pex
5 sample_trace.pex
6 PETrainer.peg
Exit
to Text...
Packets to CSV Text...
to Generator File Format...
Pkt Link Split
MWr(64) RequesterID Tag Address 1st BE Last BE
11:00000 000:01:2 3 781F33AB:12340000 1111 1000
ECRC LCRC Idle Time Stamp
0D632C96 0x36214D17 0.000 ns 0000 . 000 000 000 s
MRd(32) RequesterID Tag Address 1st BE Last BE
00:00000 000:01:2 4 00010000 1111 1111
Time Delta Time Stamp
0000 . 000 016 480 s
Time Delta Time Stamp
32.000 ns 0000 . 000 016 576 s
00:00000 000:01:2 4 00010000 1111 1111
Time Delta Time Stamp
96.000 ns 0000 . 000 016 608 s
AckNak_Seq_Num CRC 16 Idle Time Stamp
2 0xF155 0.000 ns 0000 . 000 016 704 s
Packet R G1 TLP Cpl CplD RequesterID Tag CompleterID Status BCM
5 x1 100 10:01010 000:01:2 4 001:01:0 SC 0
Ready
Search: Fwd

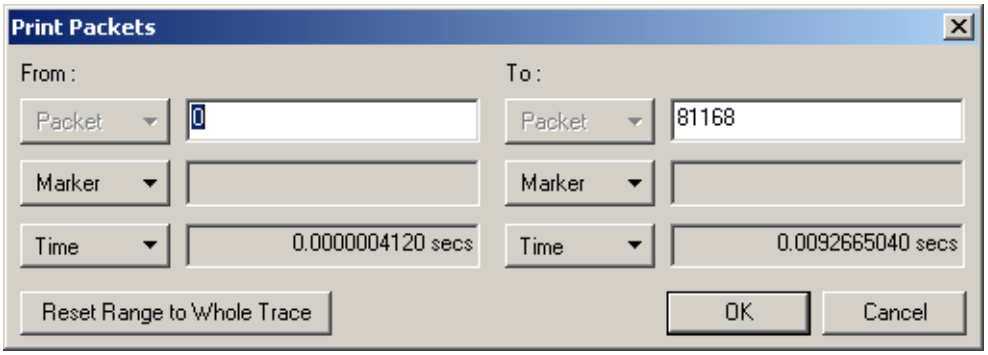
4.14 Printing Data Files

To print all or part of the open CATC Trace:

Step 1 Select **File > Print** from the menu or

click the **Printer** button on the toolbar.

The Print Packets dialog opens:



Step 2 To select a range of packets, enter values in the **From packet #** and **To packet #** fields and click **Print**.

Step 3 To print an entire file, leave the From and To fields empty and click **Print**.

The specified traffic information is printed as currently displayed, in color or gray scale as supported by your printer. Any CATC Trace File comments you entered are printed following the current document name at the top of each page.

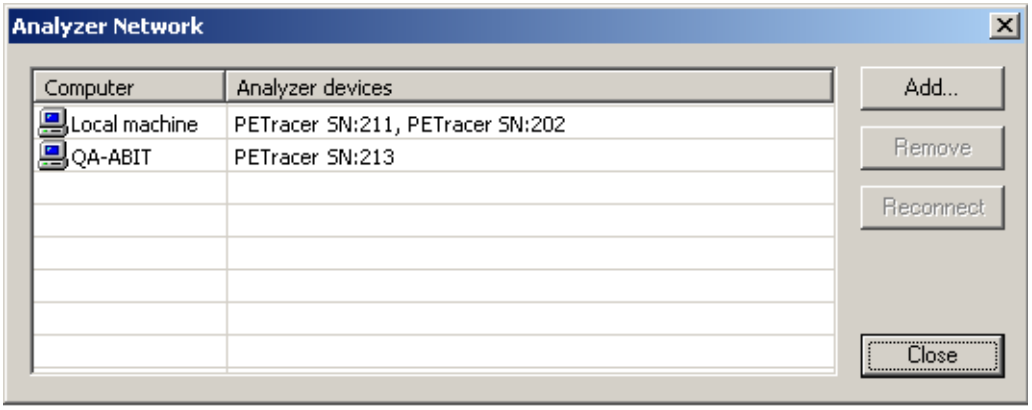
Note: CATC Trace File comments can be created by using **Edit Comment** on the File menu.

4.15 Analyzer Chat Window

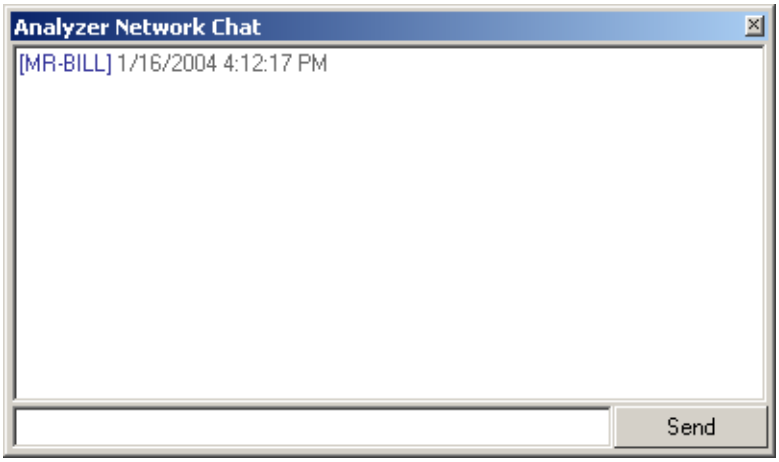
PE*Tracer* has a Chat window that allows you to communicate with users on remote host machines. For Chat to work, two conditions must be met:

1. The host machines must have PE*Tracer* software installed and running.

2. The host machines must be listed in each other's Network Browse list. This means that your host machine must have the remote host machine listed in its Network Browse window and the remote host machine must have your host machine listed in its Network Browse window.



If the above conditions are met, a Chat session is initiated by running the command: **View > Analyzer Network Chat Bar**. The following dialog opens.

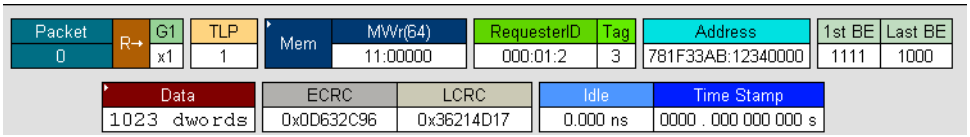


Enter some text, then press **Send**. The message is then broadcast to all host machines listed in your network browse window. If a target host machine also lists your host machine in its Network Browse window, then it can receive your message. When the message arrives, the Chat window automatically opens.

Chapter 5: Reading CATC Traces

5.1 Viewing PCI Express CATC Traces

PE*Tracer*™ displays traffic as labeled, color-coded, and time-stamped rows.



Tool tips provide details about fields within the CATC Trace. Hold the mouse cursor over a field to see a tool tip.

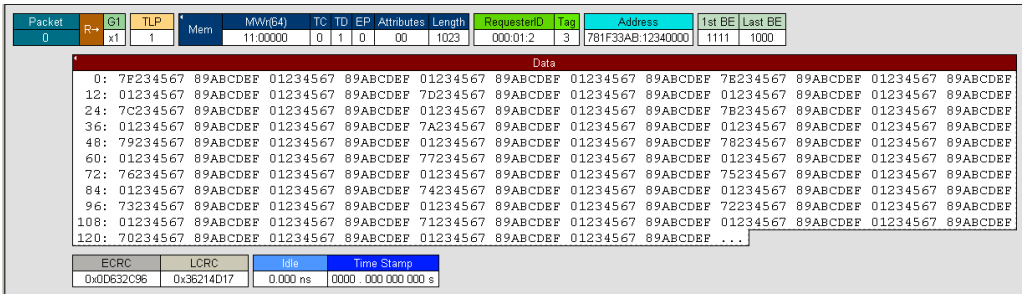
Additional information is available from pop-up menus. For example, if you click the left mouse button on the first cell in a packet a menu appears with an option to view Raw 10b Codes.

5.2 Expand and Collapse Data Fields

Packet data fields are displayed in a short format by default.

You can view a data field's long format by performing one of the following three actions:

- Click the **small triangle** in the left corner.
- Double-click anywhere in the data field.
- Click once in the Data Field with the left mouse button, then choose **Expand Data** from the pop-up menu.



A repeat of any above methods causes the display to return to a Short Data format.

5.3 Resizing Cells

Data cells can be resized by pointing the mouse pointer on the edge of a data cell, depressing and holding the left mouse button, and then repositioning the mouse pointer while keeping the mouse button depressed.

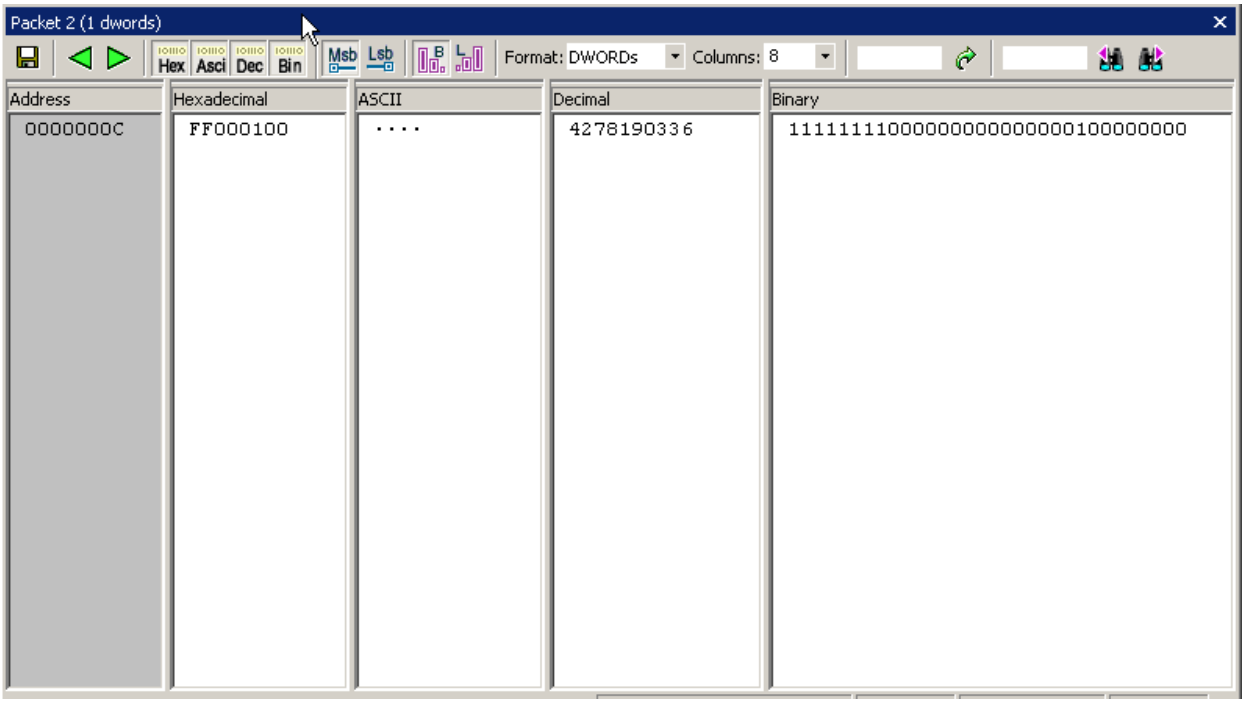
5.4 Pop-up Menus

The Analyzer software makes extensive use of pop-up menus. In some instances, pop-up menus provide the only means of accessing dialog boxes that contain detailed information about cells within the CATC Trace, for example, the Show Configuration Space dialog box.

To see a pop-up menu, left-click or right-click a **cell** within the CATC Trace. Right-click or left-click behavior depends on the Display Options setting. For default left-click, the right-click menu is not cell-dependent. For other left-click behavior, the type of menu that opens varies depending on the type of cell that is selected. Take some time to explore CATC Traces and the various pop-up menus.

5.5 View Data Block

To view the raw bits that make up the data in a data field, left-click a data field, then click or select **View Data Block** from the pop-up menu to display the Data Block window.



You can display data in Hexidecimal, ASCII, Decimal, or Binary formats.

Bit Order is Most Significant Bit or Least Significant Bit.

You can display data in Big Endian or Little Endian.

Format lets you display data as BYTEs, WORDs, or DWORDs.

Columns lets you select the number of columns.

You can enter hexidecimal offset values.

You can go to or search Previous or Next.

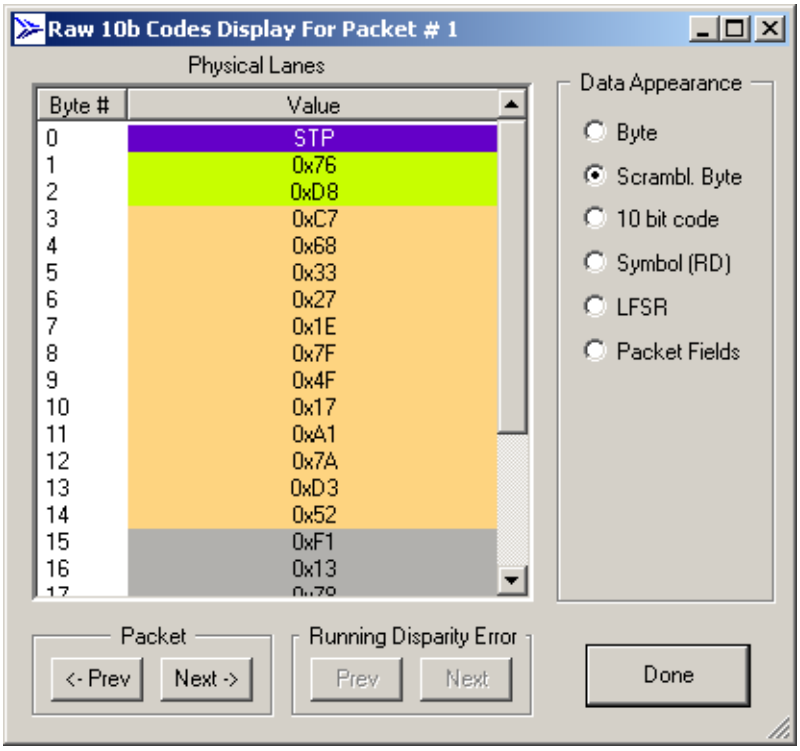
5.6 Show Raw 10b Codes

You can view the raw bits that make up the data field by left-clicking the field and selecting **View Data Block** from the pop-up menu.

To view Raw 10b Codes:

Step 1 Left-click the **first cell** in a packet.

Step 2 Select **Show Raw 10b Codes** from the pop-up menu to display the Raw 10b Codes window.



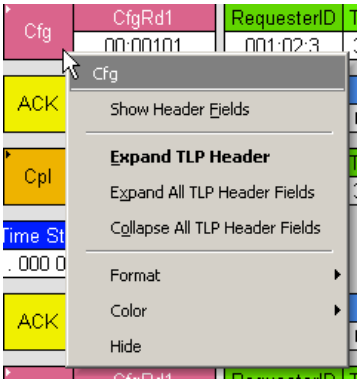
Step 3 To change the format of the data, use the options along the right side of the dialog.

Step 4 To navigate the CATC Trace, use the **Prev** and **Next** buttons.

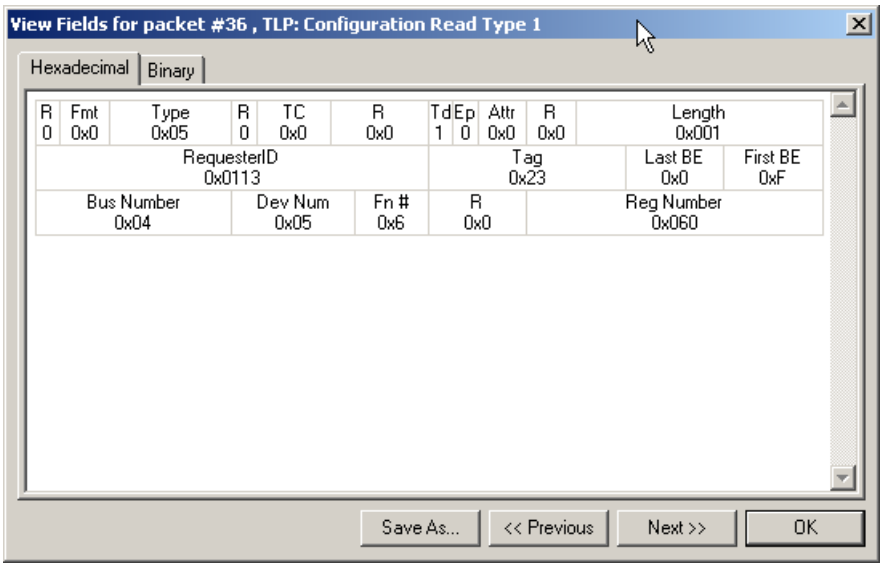
5.7 Show Header Fields

You can view details about header fields by opening the Show Header Fields dialog box.

Step 1 Click a **header.** A pop-up menu appears.



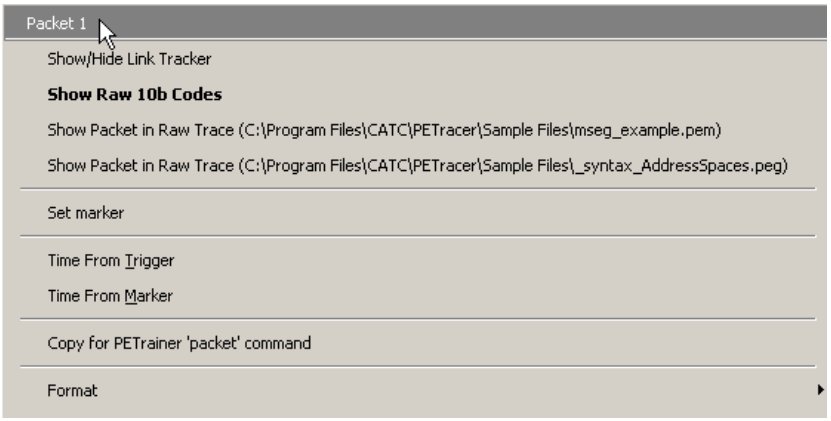
Step 2 Select **Show Header Fields**. The following dialog box opens.



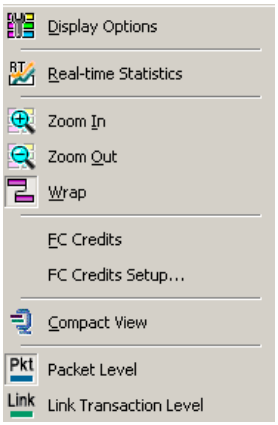
Step 3 Use the **Prev** and **Next** buttons to navigate to other headers.

5.8 Packet Cell Popup Menus

The Packet cell has a left-click pop-up menu that includes the Show Raw 10b Codes command:

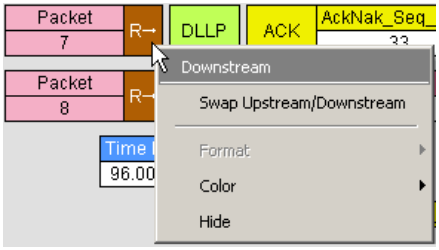


The right-click pop-up menu from Packet cell is:



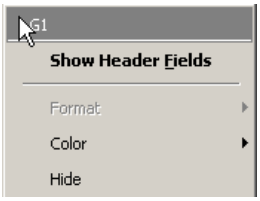
Packet Header R-> Cell Popup Menu

The Packet Header R-> cell has a pop-up menu with the Swap Upstream/Downstream command, which changes the directionality of the packets in the CATC Trace.



Packet Header G1 Cell Popup Menu

The Packet Header G1 cell has a pop-up menu with the Show Header Fields command (see “Show Header Fields” on page 74), which exposes a detailed view of the selected Header field.

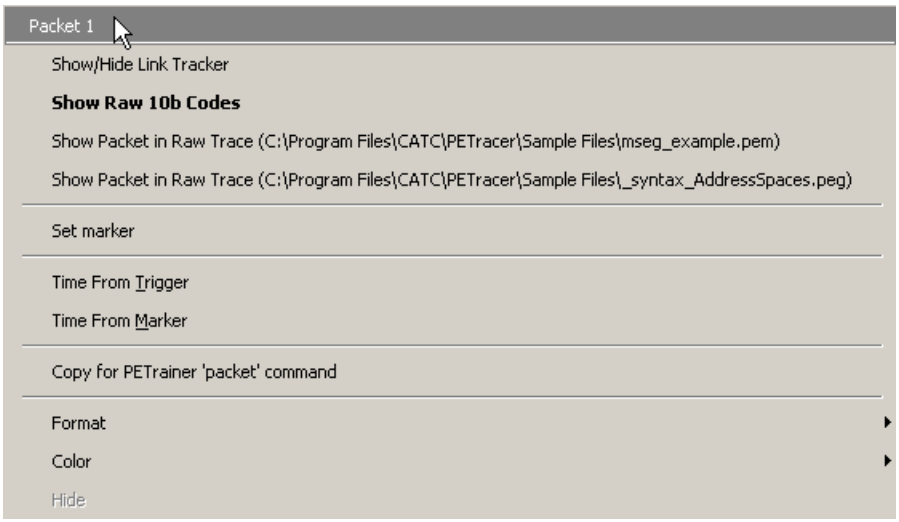


5.9 Set Marker

A marker is a unique label for a packet that allows you to go to that packet and also serves as a **comment string** for a specific packet. When you select a marker, the identified packet appears at the top of the screen. Packets that have been **marked** have a red bar on the left edge.

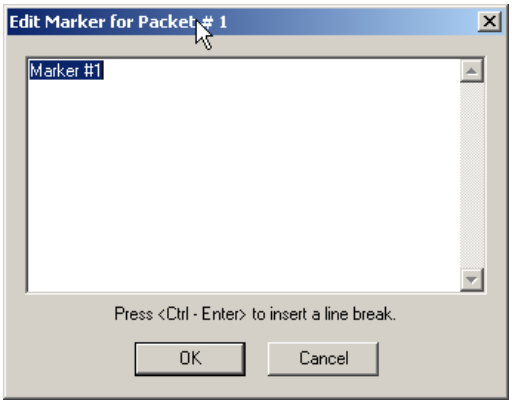
To set a marker, perform the following steps:

Step 1 Left-click the **Packet** field of the packet you want to mark.



Step 2 Click **Set Marker**.

Step 3 When the Edit Marker for Packet # pop-up appears, enter a unique identifier for the packet in the Comment field.

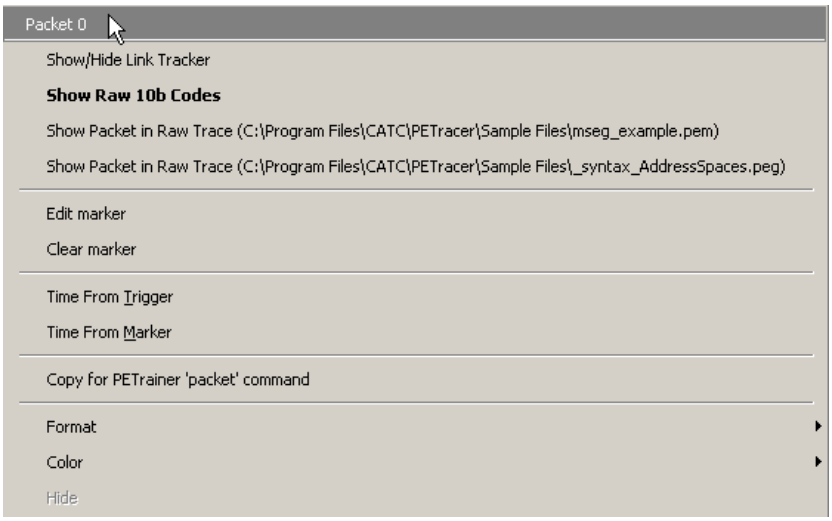


Later, you can go directly to this packet using the Go To Marker operation in the Search Menu.

5.10 Edit or Clear Marker

To change a markers identifier, or clear (delete) the marker:

Step 1 Left-click the **Packet** field of the desired packet to display a pop-up menu:



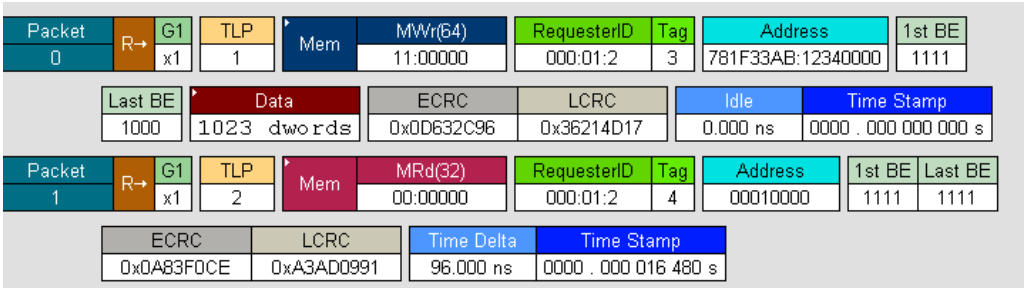
Step 2 Choose **Edit Marker** and enter a new identifier into the Edit Marker for Packer # pop-up, or
Choose **Clear Marker**. When you choose Clear Marker, the marker is removed and the red line disappears.

5.11 Decoding Traffic

The PE*Tracer* software has three decode levels:

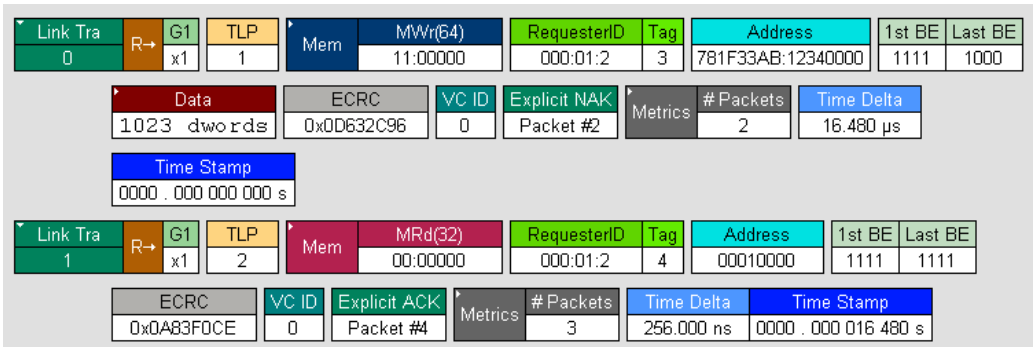
Packet

Packet level decode Pkt includes all TLP packets, DLLP packets, and all ordered sets.



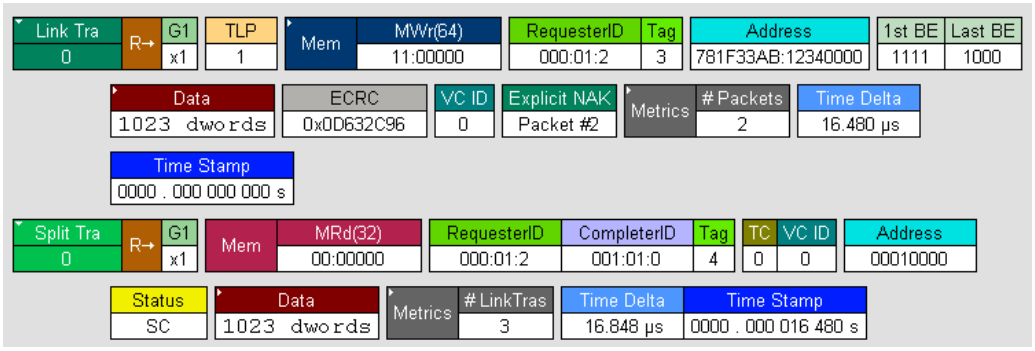
Link

Link level decode Link is composed of TLP packets matched with a corresponding ACK or NAK coming from the opposite direction.



Split

Split level decode Split is composed of two Link transactions, the Request TLP and the Completion TLP from the other direction.



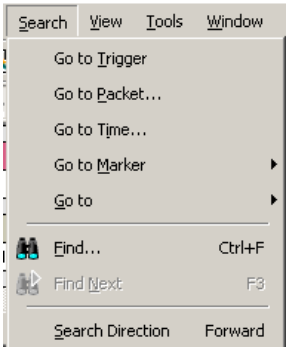
Chapter 6: Searching CATC Traces

This chapter describes how to search for CATC Trace events.

6.1 CATC Trace Search Overview

Several search commands let you navigate a CATC Trace view to search for key events, such as errors and triggers.

To view the search options, click **Search** in the Menu bar.



6.2 Go to Trigger

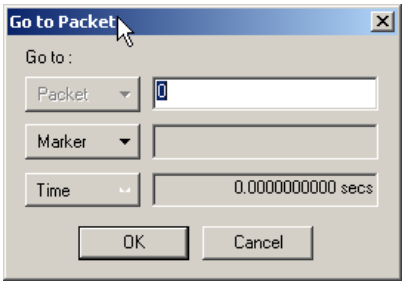
To position a trigger packet at the top of the screen:

- Select **Search > Go to Trigger**.

6.3 Go to Packet

To position a packet at the top of the screen:

Step 1 Select **Go to Packet** from the Search menu. A pop-up menu prompts you for the packet number, marker, or time.



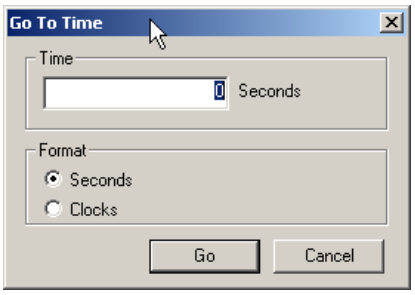
Step 2 Enter the packet number, marker, or time.

Step 3 Click **OK**.

6.4 Go to Time

To position a specific time at the top of the screen:

Step 1 Select **Go to Time** from the Search menu. A pop-up menu prompts you for the time in Seconds or Clocks.



Step 2 Enter the time and format (seconds or clocks).

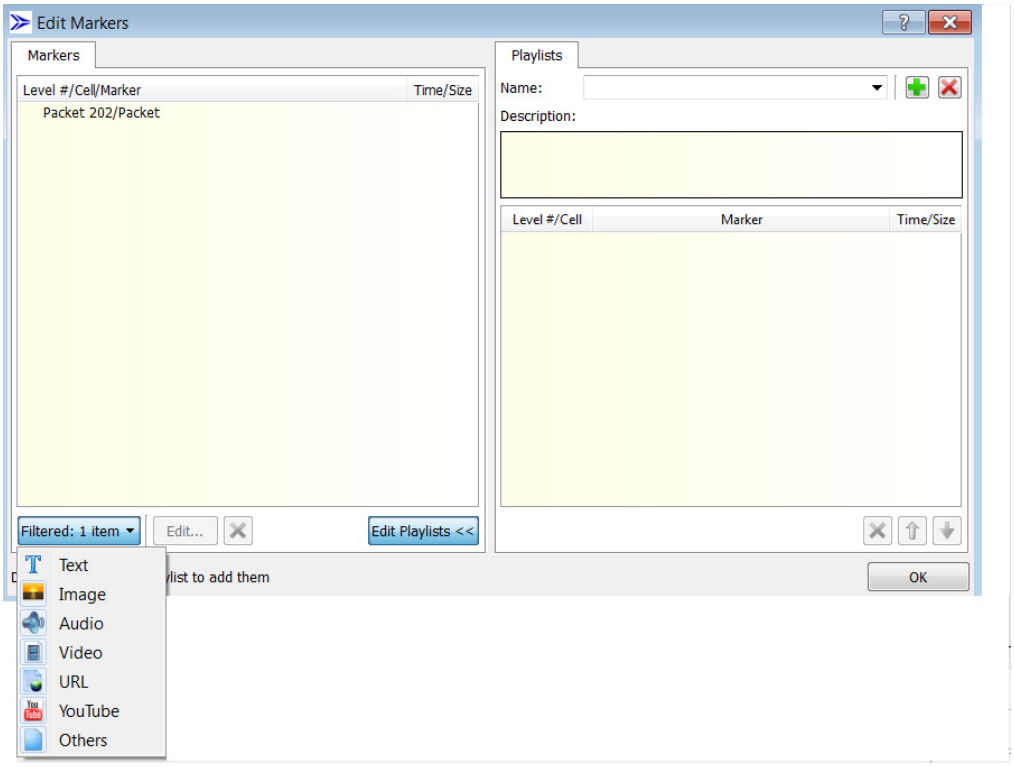
Step 3 Click **Go**.

6.5 Go to Marker

Use this operation to go directly to a specific packet that has been marked with a unique marker by the Set Marker operation.

To go to a marker:

1. Select **Go To Marker** from the Search Menu.
2. Select the marker you want from the fly-out menu. Alternatively, select **All Markers** to display the All Markers window, then select a marker and click **Goto**.



The packet you want appears at the top of the screen. Marked packets have a red bar on the left edge.

Markers

This section explains the features of Markers. A marker is an entity that flags a physical or logical item of interest within a trace file. A marker contains one or more attachments. You can add a marker to a trace file or unmark a trace file by removing the marker.

Markers are represented graphically in a different way in the application.You can not only add markers to the packets but it is granular enabling you to also add markers to individual cells.

Markers Overview

This functionality provides the user an easy way to navigate through attachments which is a discrete piece of information or data added to a marker, for example, a text description or file, an attachment of a trace file by a predefined order, video or audio files, URL links or any other files.

Functionality of Markers

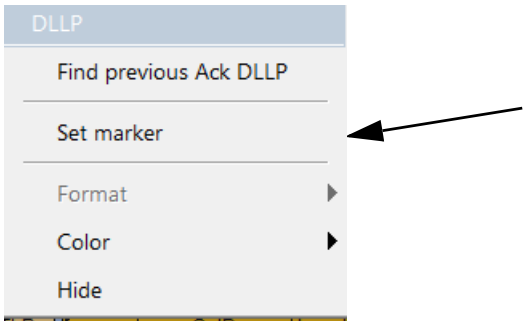
The markers functionality allows you to add markers to:

- Whole packets or frames
- Specific Cells
- Specific values within a cell: Bytes, words, etc.

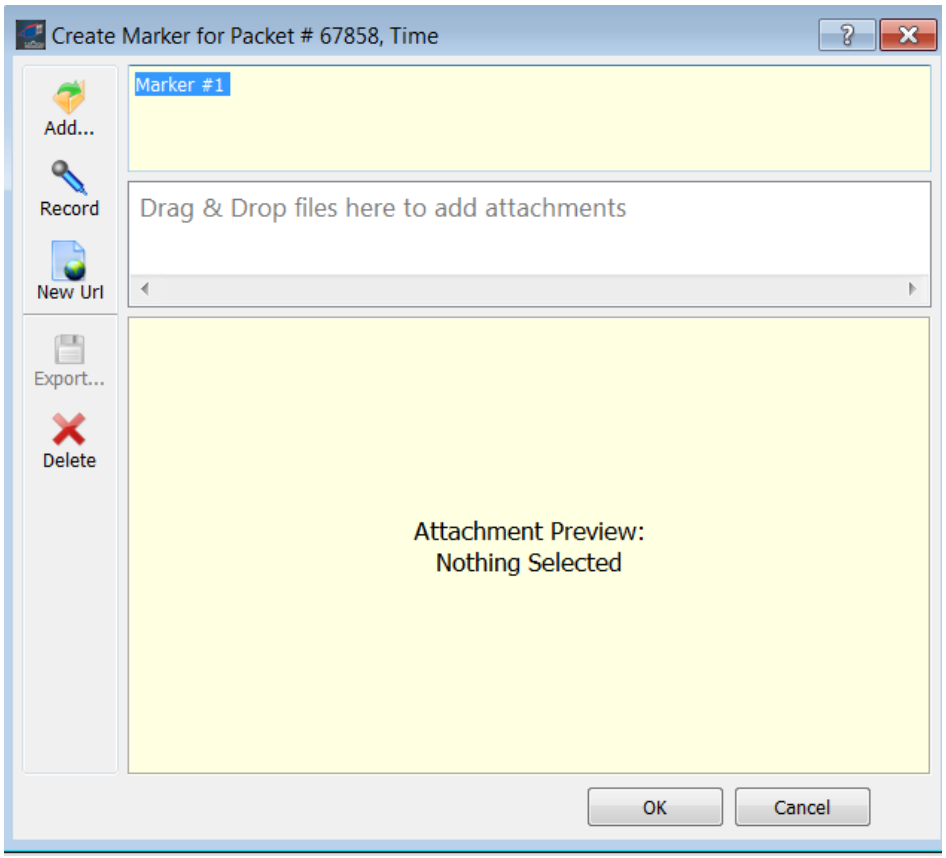
You can add attachments to markers.

Right-click on any cell of a packet and select **Set Marker** from the menu as shown below**.**

select an option.



The Create Marker dialog displays (see Figure on page 85).



Create Marker for Packet Dialog

As shown above you can:

Add...	Add icon. Click on this icon to add any file. See "Adding an Attachment" on page 86.	Export...	Export icon. Click on this icon to export an attachment.
Record	Record icon. Click on this icon to record audio. See "Recording an Audio File" on page 87.	Delete	Delete icon. Click on this icon to delete an attachment
New Url	New URL icon. Click on this icon to add any URL.		

Attaching Markers

You can attach a discrete piece of information/data to a marker, for example, a text description or file, an attachment of a trace file by a predefined order, video or audio files, URL links or any other files. You can also remove an attachment from a Marker.

Adding an Attachment

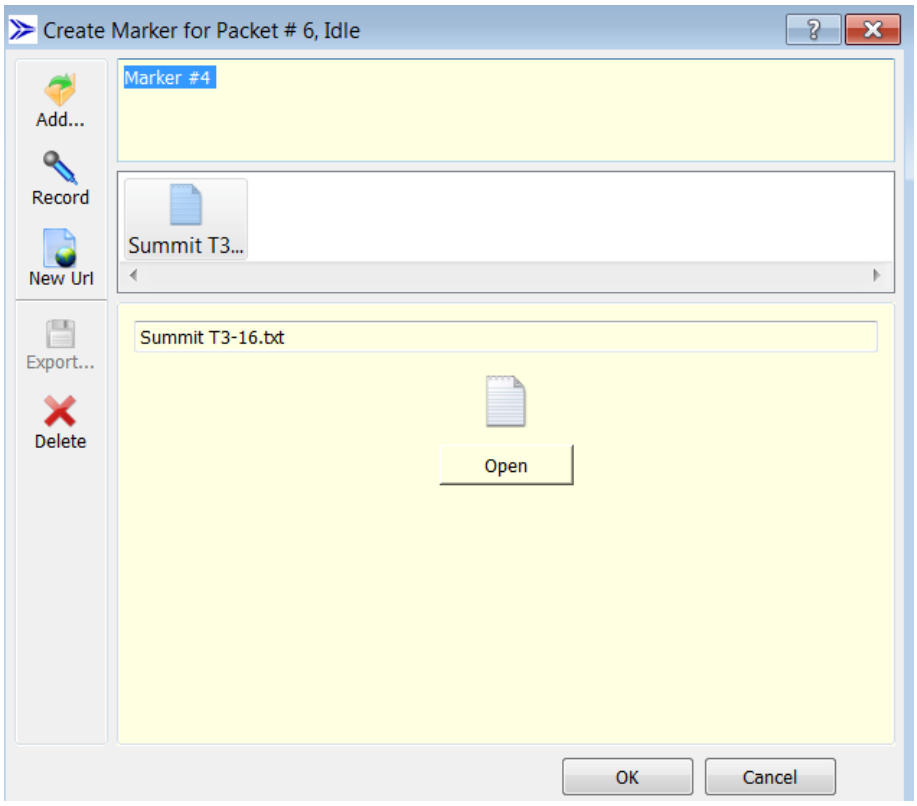
Perform the following steps to add an attachment to a marker:

1. Right-click on any cell in the trace and select **Set Marker.**

   The Create Marker window displays.
2. Click on the **Add** icon.

   The **Add File to the Marker** dialog displays.
3. Go to the file and select it to add it to the marker as an attachment.
4. Click **Open**.

   The file will appear in the Create Marker for Transfer... dialog as shown below. The Marker # appears in the top panel, the icons are displayed in the second panel and you can click on the icon on the third panel to view the file you are about to attach.
5. Click **OK** to add the attachments.



Create Marker for Transfer Dialog

Recording an Audio File

The audio quality supports voice attachment and is not designed for high-quality audio Playback of audio content is not limited and depends on the formats supported by the installed playback engine.

Click the record icon and speak into the microphone to record an audio file.

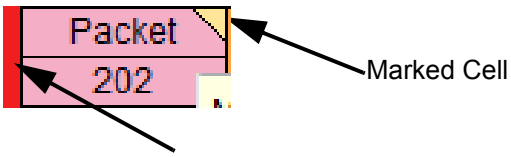
Note: This functionality is disabled if a microphone is not installed.

Video Files supported

The user can attach video clips to the trace file (“add to the marker”). The playback of the Video clips is limited to the formats that are supported by the video codecs installed in the system.

Attachment Types and Visualization

The markers are represented graphically by a yellow triangle at the top right of the marked item and a red vertical bar at the left-most cell of a packet as shown below.



A marker may comprise any number of attachments of any types.

Embedded Attachments to a Marker

Embedded files are attached to the item marked and transported with the trace. You can embed the following types of files to a marker:

- Audio Files
- Video Files
- Image Files
- YouTube Files
- Web Pages
- Text Attachments
- Other Attachments

Attachments are embedded in the marker and saved in the trace file. Once attachments are placed in a marker, the marker can then be presented to a user in a story structured form. On opening the marker the window resembles the marker editing dialog.

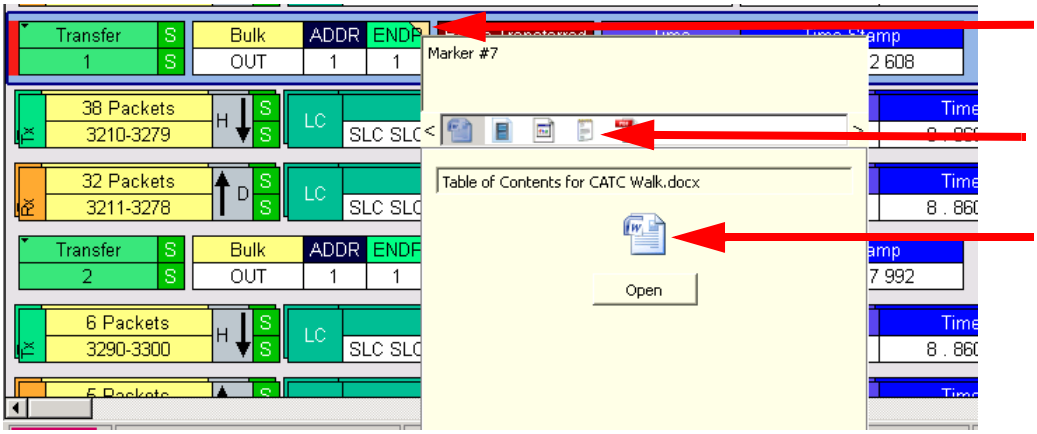
Note: The use of Audio and Video markers is limited to the file types supported on a user's system. CATC Walk has been tested with .mp3 and .wmv files, which are supported by Windows as installed. If additional codecs are installed, they should also work, but it is the user's responsibility to choose formats that will work for whomever they intend to exchange CATC trace files (no different than email attachments in this regard). Because of this dependency on installed codecs, there are situations where bugs in the codecs supplied by Microsoft or third-party applications can prevent proper operation of the Teledyne LeCroy PETracer application. See the Teledyne LeCroy PETracer Application

Read-Me file for more information if you have problems with application crashes, etc.

Viewing Attachments of a Marker

If you hover over the marked cell (yellow triangle at the top right of the marked item), refer to "Attachment Types and Visualization" on page 88, a window pops up displaying the contents of the marked cell as shown below.

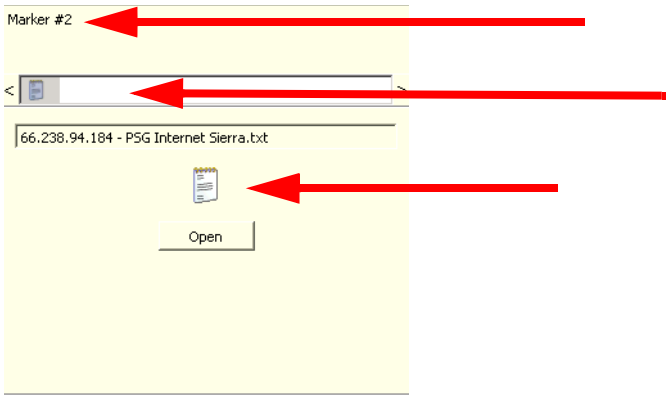
To view an attachment you can click on any of the icons in the attachment bar and or you can double-click on the icon itself to open the attachment.



Pop-up Displaying Marker Contents

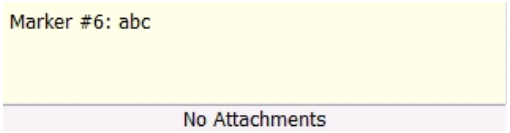
Text

The text attachment is displayed in the icon bar and in the main pop-up window. Text attachments are always shown at the top. The attachment file name is displayed in the field as shown below.



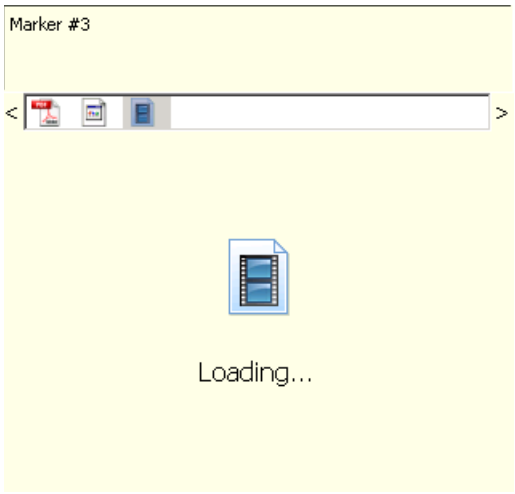
Text Attachment Pop-up Window

If there is no attachment, **No Attachments** displays in the status bar at the bottom.



No Attachments Pop-up Window

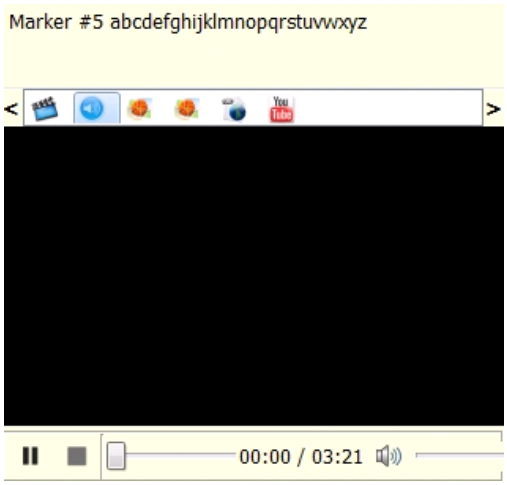
If there are attachments, the status bar is hidden. You can move the cursor to an attachment icon in the list view and a preview of the attachment starts.



Preview Attachments Pop-up Window

Audio

Audio snippets that are recorded and attached to certain point of interest in a trace can be played. The basic Play, Start, Stop, Pause buttons are displayed to listen to the audio file.



Video

Video clips that are recorded and attached to certain point of interest in a trace can be played. The video is embedded in the tooltip with simple playback controls.

File Attachment

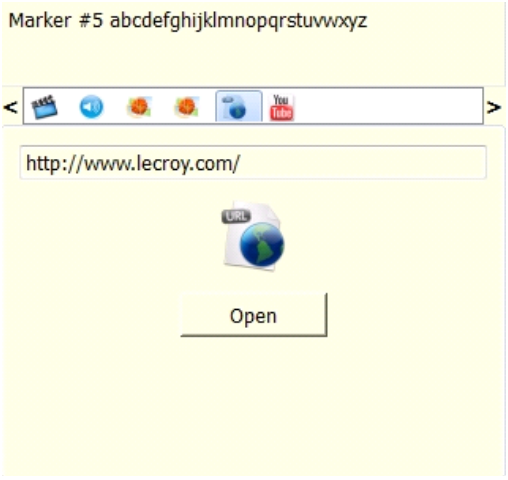
You can attach any kind of file, including images, PDFs, documents, media files, etc.

URL Link

You can specify a URL that links to a web page (i.e., YouTube), a network location, or a local file-system location.

Web Link

Due to the small size, the web page is not embedded in the callout. You can use the **Open** button to open the web link in the default web browser.



YouTube Video

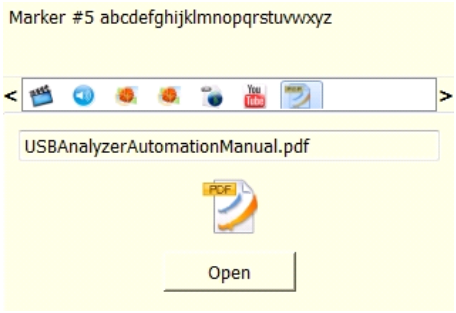
YouTube's video player is embedded for YouTube Video playback.

Images

The image is embedded in the trace.

Other Attachments

Click the **Open** button to open the attachment file with the system's default application for that file type.



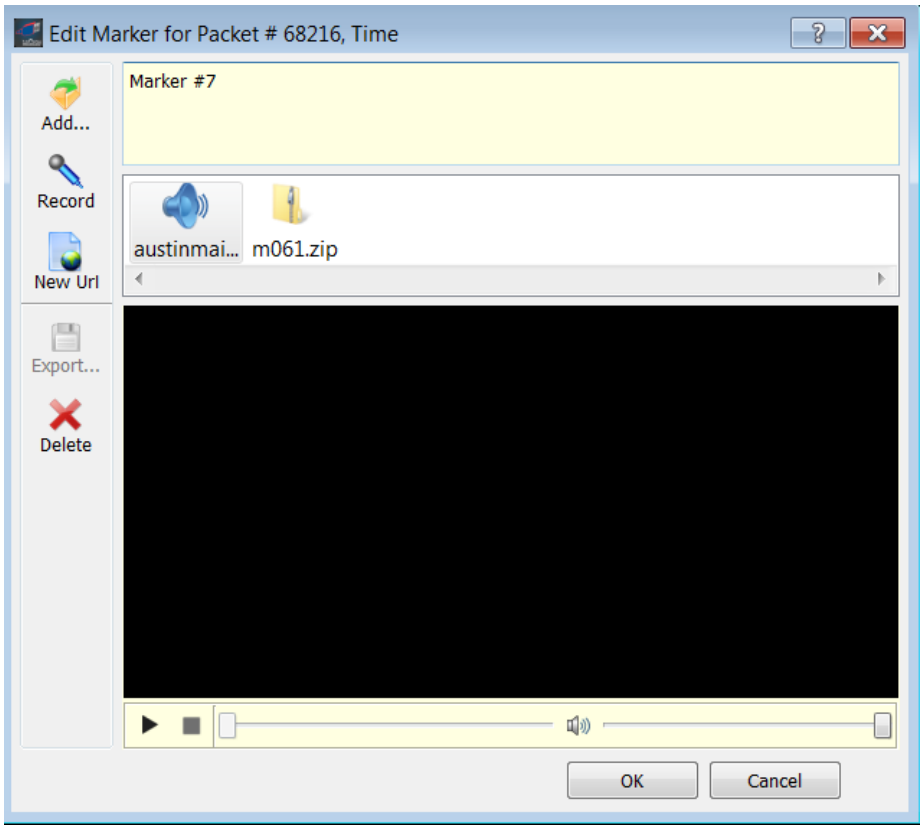
Edit Marker

To edit a marker, right-click on the marked item and select **Edit marker** from the menu. The Edit Marker dialog displays. This Edit Marker window can be used to edit one marker at a time.

You can do the following in the Edit Marker dialog:

- Edit text attachment.
- Record audio attachment.
- Add URL link attachment

- Add a file attachment. Click on **File** and click the **Open** button or drag and drop the file.
- Preview audio/video/image/URL/YouTube attachment or open other files with system default application.
- Save an attachment to a file.
- Remove attachment.



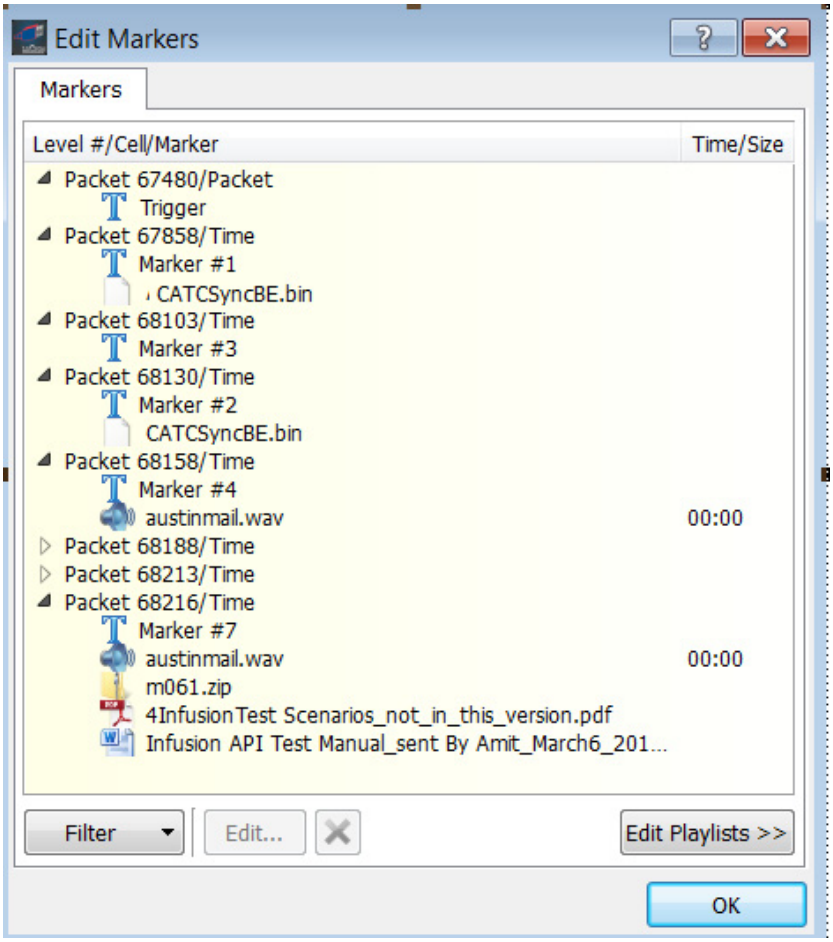
EDIT Marker for Packet Dialog

All Markers Window

Select **Search > Go to Marker > All Markers** or press **Ctrl + M** to display a list of all the markers in the file. The window uses a tree structure to show packets, fields and markers. The features of the Markers window are:

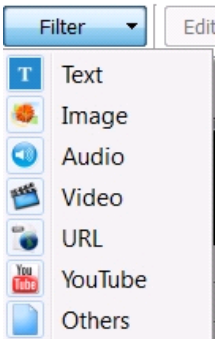
- All Markers are displayed
- All attachments within the marker are displayed
- You can collapse or expand the item marked to view the attachments
- The Time and size of audio and video files are displayed
- You can edit Playlists from this window

- You can edit or remove a marker from this location
- You can filter attachments within the marker



Edit Marker Dialog

You can filter to show or hide text, image, audio, video, URL, YouTube videos and other files.

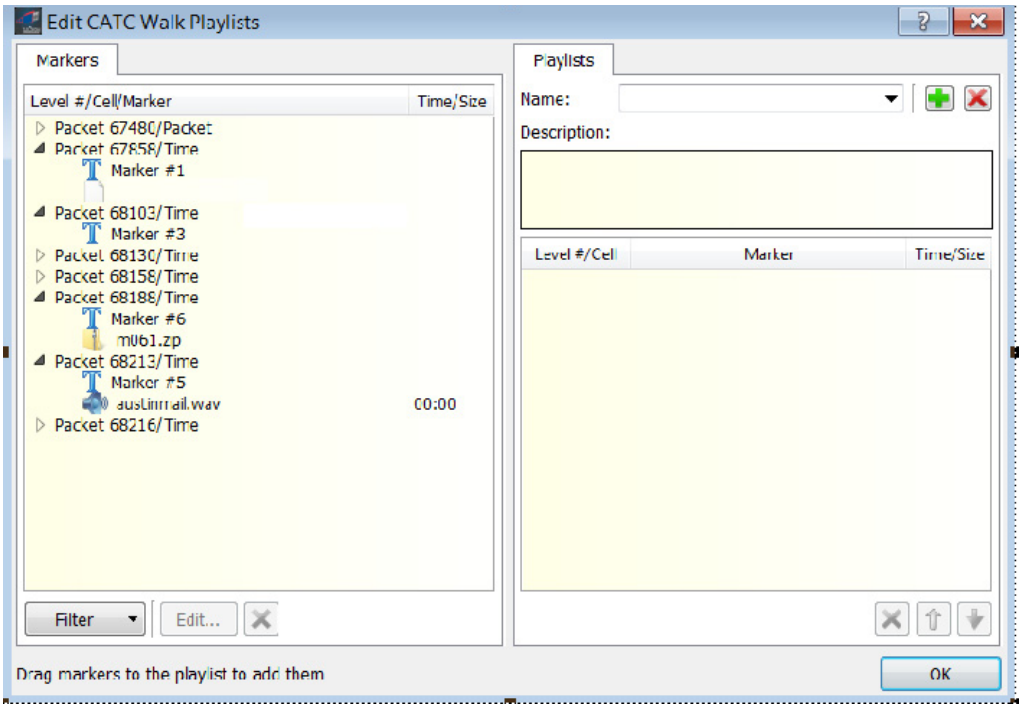


Filter Dialog

6.6 CATC Walk Playlist

This feature allows users to configure sequences of attachments into playlists. Any arbitrary order of attachments are allowed, and there are no limits on the number of playlists supported. This feature can be used for collaborating among developers as well for training, support and marketing purposes.

To access a playlist click on the **View** menu in the top toolbar of application, select **CATC Walk** and then select **Manage Playlists** as shown below.



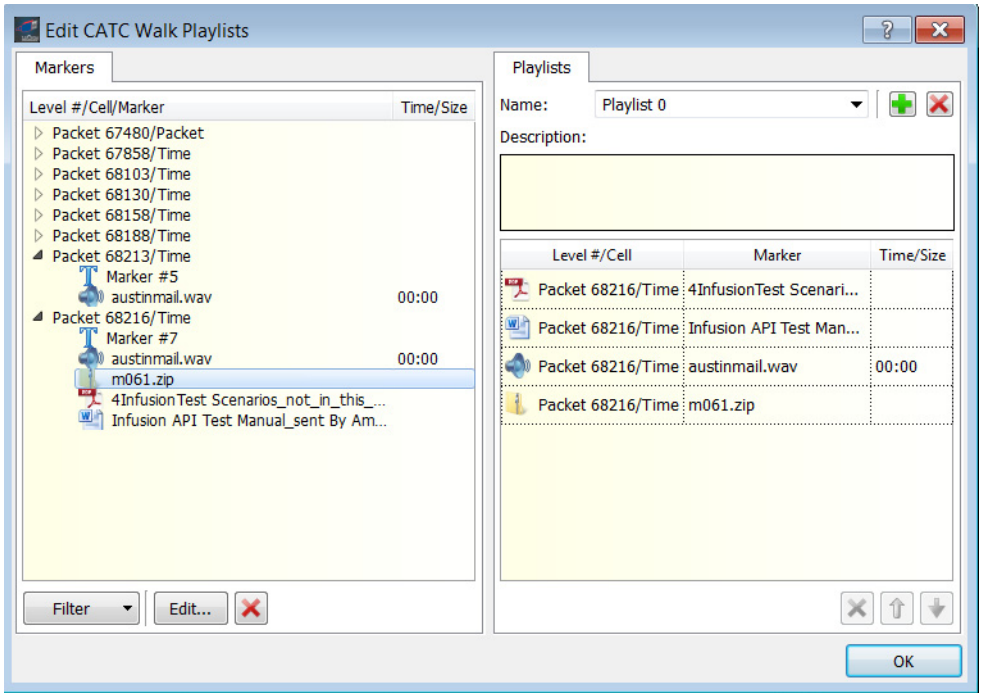
Edit CATC Walk Playlists Dialog

Playlist Functionality

You can do the following to manage playlists:

- Remove or edit current playlists
- Edit the playlist name
- Edit the playlist description
- List the sequence of attachments in current playlist
- List of all available attachments and drag/drop to a playlist.

As shown in the previous figure the Playlist window lists the markers with their attachments on the left and the playlist on the right.



Edit CATC Walk Playlists Dialog

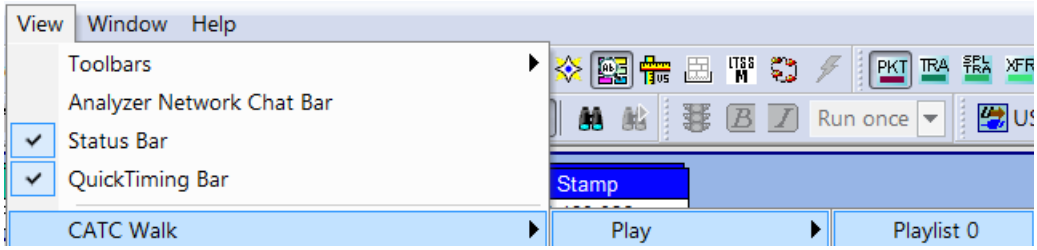
You can drag and drop and item or attachment from the **Marker** panel into the **Playlist** panel and build a story. Give a description of the playlist in the **Description** field and you can give a name to the playlist in the **Name** field.

You can add a new playlist by clicking on the green plus sign (**+**) on the right top corner of the Playlist panel, or delete a playlist by clicking the red (**x**) button.

If you have more than one playlist saved click on the Name drop-down arrow to select it. The drop-down menu lists all the available playlists

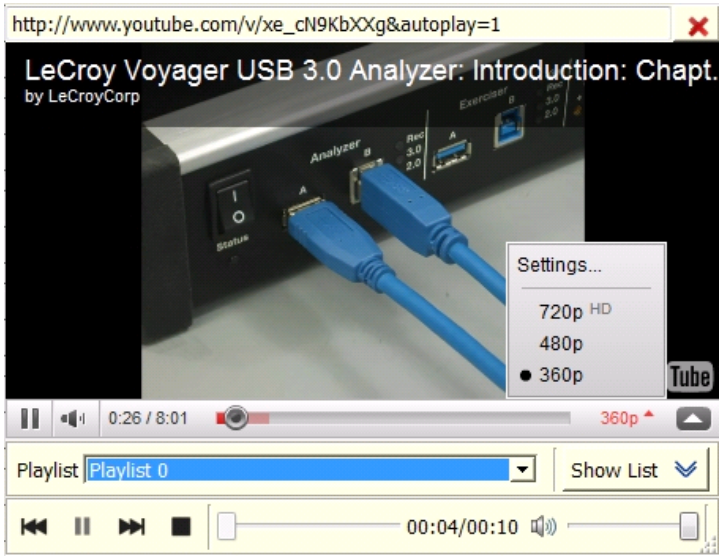
Playback Window

To playback a playlist, click on the **View** menu in the top toolbar of application, select **CATC Walk** and then select **Play > Playlist 1** as shown below.



View Dialog

The attachment item starts to play in the playback window as shown below.



Playback Window

The playback window is resizable. The close button at the top right corner and the size grip for resizing at the bottom right corner will hide automatically when moving the cursor out of the window.

Users can provide commentary to a captured trace, converting it into a script or a story and can transfer this meta-information to others. Playlist Playback Controls.

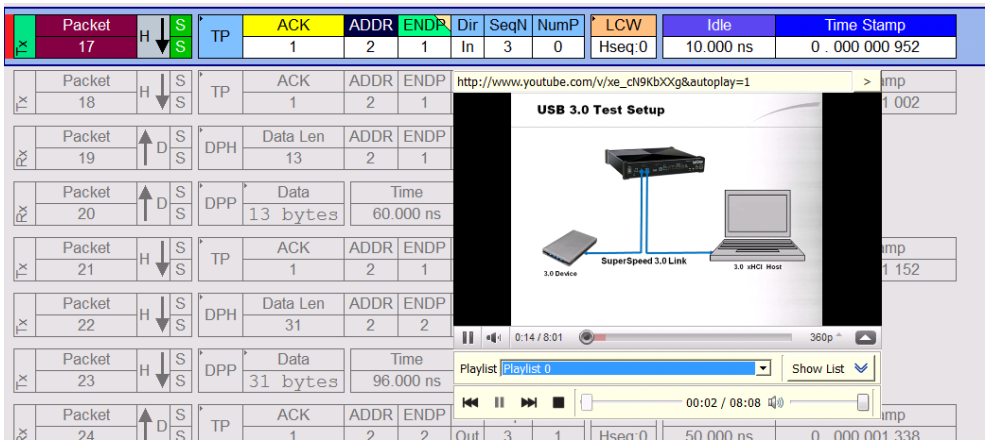
Playlist Playback Controls

The playlist playback control buttons are:

- Play/Pause
- Stop
- Jump to Next attachment
- Jump to Previous attachment
- Seek slider for seeking to positions in media streams
- Volume slider
- Playback speed slider (for text attachments)

As a playlist is played back, the playback window is displayed in close proximity to the marked area, just like a regular tooltip window.

As the playback progresses, the view jumps to the element corresponding to the current attachment being played and the marked element is highlighted. During playback the user is prevented from interacting with the trace. To reinforce this restriction, the trace view is grayed-out visually, and only the packet with the item corresponding to the current attachment is colorized.



Playback Window

6.7 Go To Menu

The **Go To menu** in the Search menu provides a quick way to search for a packet based on a simple condition. You can search for the following types of events:

- TLP Type
- DLLP Type
- Ordered Set
- Link Event
- Traffic Class
- DLLP Virtual Channel
- TLP Virtual Channel
- Direction
- Speed
- Link Width
- Requester ID
- Completer ID
- Data Lengths
- Errors

6.8 Search Direction

Search direction can be toggled back and forth by using the command under the Search menu. Search Direction controls the direction of the search. Each time Search Direction is selected, the search order is reversed. For example, if the previous search was **forward**, choosing **Search Direction** toggles the current search to **backward**.

To verify the direction of a search look at the lower right corner of the screen. **Search: Bwd** or **Search: Fwd** should appear. If a direction is not indicated, it means that the status bar is turned off.

To turn on the Status bar, select from the menu **View > Status Bar**.

Keyboard shortcuts can also be used to control search direction:

- **Control-f** means Search Forward.
- **Control-b** means Search Backward.

6.9 Find

Find allows you to conduct complex searches in a CATC Trace. You can search by protocol level (Packets, Link Transactions, Split Transactions).

You can search packets by Event Group: TLP Type, TLP Header, TLP Prefix (Summit T2-16 only), TLP Requester ID, TLP Completer ID, TLP Data Pattern, TLP Data Lengths, TLP Tag, TLP Sequence Number, DLLP Type, DLLP Header, DLLP Virtual Channel, ACK/NAK Seq Number, Ordered Sets, Link Event, Direction, Errors.

You can search link transactions by Event Group: TLP Type, Traffic Class, Virtual Channel, Direction, Requester ID, Completer ID, Status, Tag.

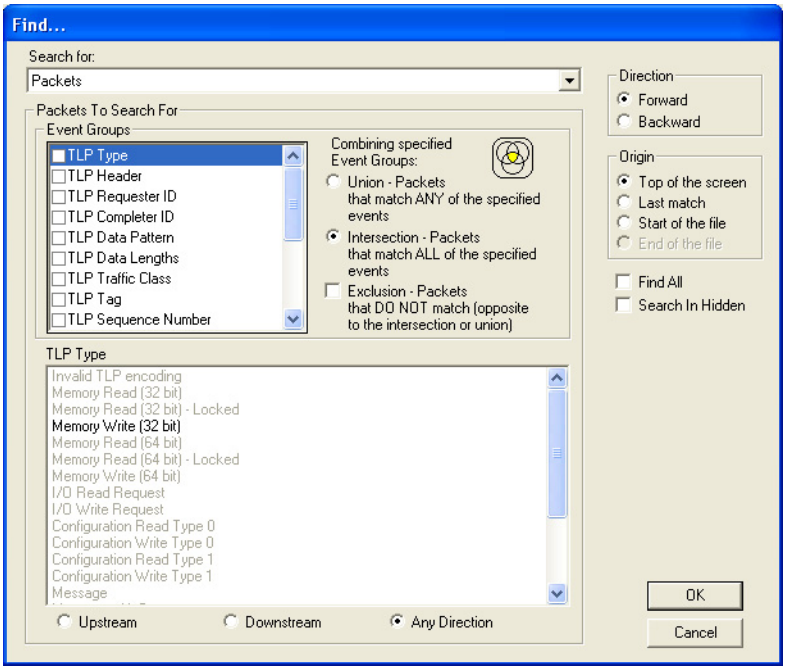
You can search split transactions by Event Group: TLP Type, Traffic Class, Virtual Channel, Direction, Requester ID, Completer ID, Status, Tag.

The options Union, Intersection, and Exclusion allow you to create complex searches such as "Find x OR y" or "Exclude all x or y."

To find a item:

Step 1 Open a CATC Trace.

Step 2 Open Find by selecting **Search > Find** from the menu or clicking .



Step 3 From the Search For menu, select a display level such as **Packets**. To search multiple levels, finish steps 3 to 9, and then repeat 3 to 9 for each additional display level.

Step 4 From the Event Groups menu, select an **Event Group**. The menu in the far right of the dialog box is context sensitive and changes to reflect the options for that group.

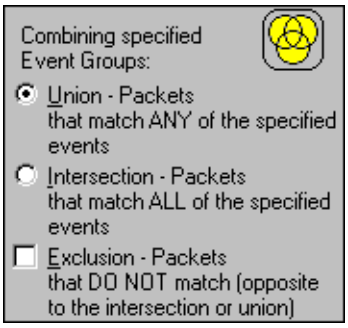
Step 5 In the menu in the far right, select one or more items.

Step 6 Repeat Step 5 for each Event Group of interest for the selected display level.

Step 7 Under Direction, select **Forward** or **Backward** to select a search direction.

Step 8 Under Origin, select a starting point for the search.

Step 9 Under **Combining Specified Event Groups**, select



The options Union, Intersection, and Exclusion let you set conditions on your searches:

- **Union**: To search for **any** of the selected criteria.
  Example: "Find packets with ANY of the following characteristics …"
- **Intersection**: To search for **all** of the selected criteria.
  Example: "Find packets with ALL of the following characteristics …"
- **Exclude**: To **exclude** items from a search. This option works in conjunction with Union and Intersection. You select Union and Exclude to exclude any of the specified traffic. You select Intersection and Exclude to exclude all of the specified traffic.
  Example: "Exclude packets with ANY of the following …" or "Exclude packets with ALL of the following …"

Step 10 Repeat Steps 3 through 9 for additional display levels.

Step 11 **Find All** displays all matching packets or transactions in a separate view.

Step 12 **Search in Hidden** includes hidden packets or transactions in the search.

Step 13 Click **OK**.

Event Groups

The Event Groups for Packets are:

- TLP Type
- TLP Header
- TLP Prefix (Summit T2-16 only)
- TLP Requester ID
- TLP Completer ID
- TLP Data Pattern
- TLP Data Lengths
- TLP Traffic Class
- TLP Tag
- TLP Sequence Number
- DLLP Type
- DLLP Header
- DLLP Virtual Channel
- ACK/NAK Seq Number
- Ordered Sets
- Link Event
- Direction
- Errors

The Event Groups for Link Transactions and Split Transactions are:

- TLP Type
- Traffic Class
- Virtual Channel
- Direction
- RequesterID
- CompleterID
- Status
- Tag

6.10 Search for the Next Packet Type

Use **Find Next**or click to search for the next packet meeting the search criteria.

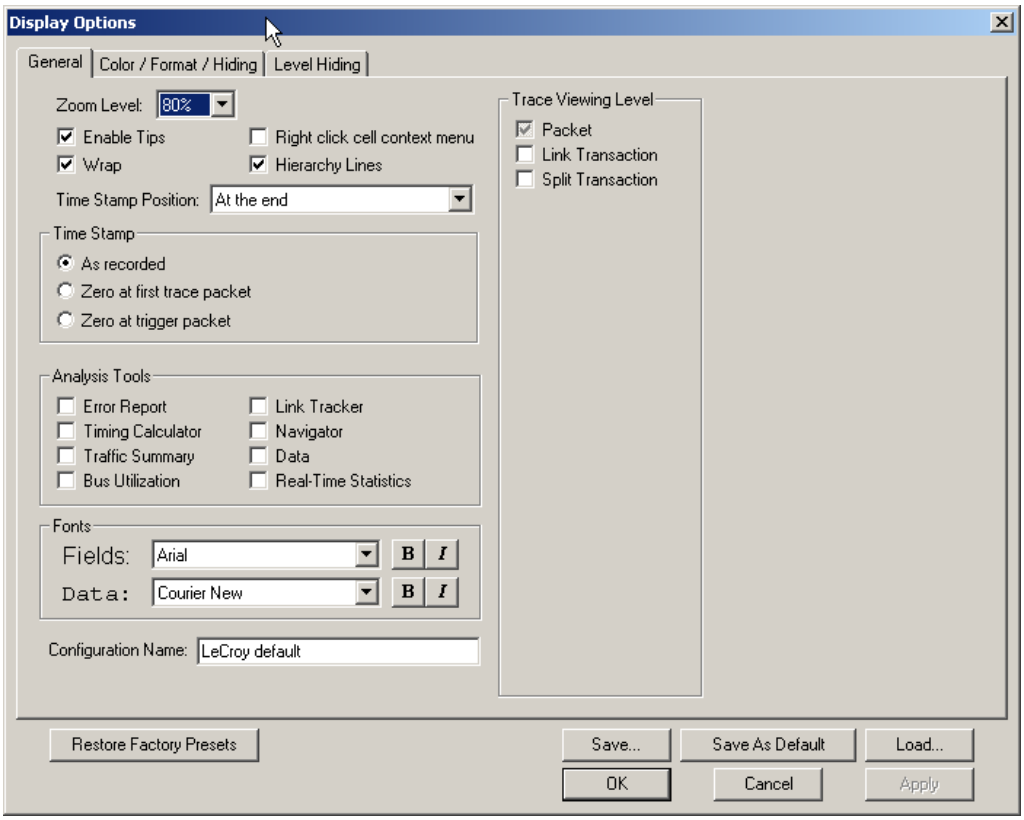
Chapter 7: Display Options

7.1 Setting Display Options

Display Options allow you to customize the colors and formats of displayed traffic.

To open the Display Options dialog at the General tab, Select **Setup > Display Options** from the menu or

click the **Display Options** button on the toolbar.



7.2 Specifying General Display Options

The Display Options General tab allows you to specify:

Zoom Level: Defines the size of packet fields in the packet view. Zoom level is adjustable as 10, 20, 40, 60, 80, 100, 120, 140, 160, 180 and 200 percent.

Enable Tool tips: Allows information to be displayed on a packet by resting your mouse pointer over it.

Wrap: Allows packets, Link Transactions, and Split Transactions to wrap within the display.

Right click cell context menu: Swaps mouse functions.

Hierarchy Lines: Adds lines to the trace view indicating relations between packets, Link Transactions, and Split Transactions.

Timestamp position: Moves timestamp location from end of packet to beginning of packet, or merges it with the packet number.

Trace Viewing Level: Allows the CATC Trace to be displayed in different hierarchical levels: Packets, Link Transactions, and Split Transactions.

Time Stamp: Gives you options for setting the timestamp to zero for either the first CATC Trace packet or the trigger packet or for leaving the stamp unchanged as it was originally recorded.

Analysis Tools Checkboxes

Error Report: Opens Traffic Summary window and displays list of errors that occurred in the CATC Trace.

Timing Calculator: Opens Timing Calculator dialog for calculating timing between events.

Traffic Summary: Displays a table of events that occurred in the CATC Trace.

Bus Utilization: Opens a graph of bus usage in the open CATC Trace.

Link Tracker: Opens window that displays traffic on a per lane basis in a strictly chronological view.

Navigator: Displays/Hides Navigation bar. The Navigation bar lets you see in a glance the position of errors and triggers in a CATC Trace and narrow the range of traffic displayed in the CATC Trace window.

Data: Displays packet payload information in various formats.

Real-Time Statistics: Opens a dialog that displays a graph of bus activity on the DUT in real-time, as well as other statistical information.

Fonts

Fonts: Allows the appearance of field text and/or data text to be defined.

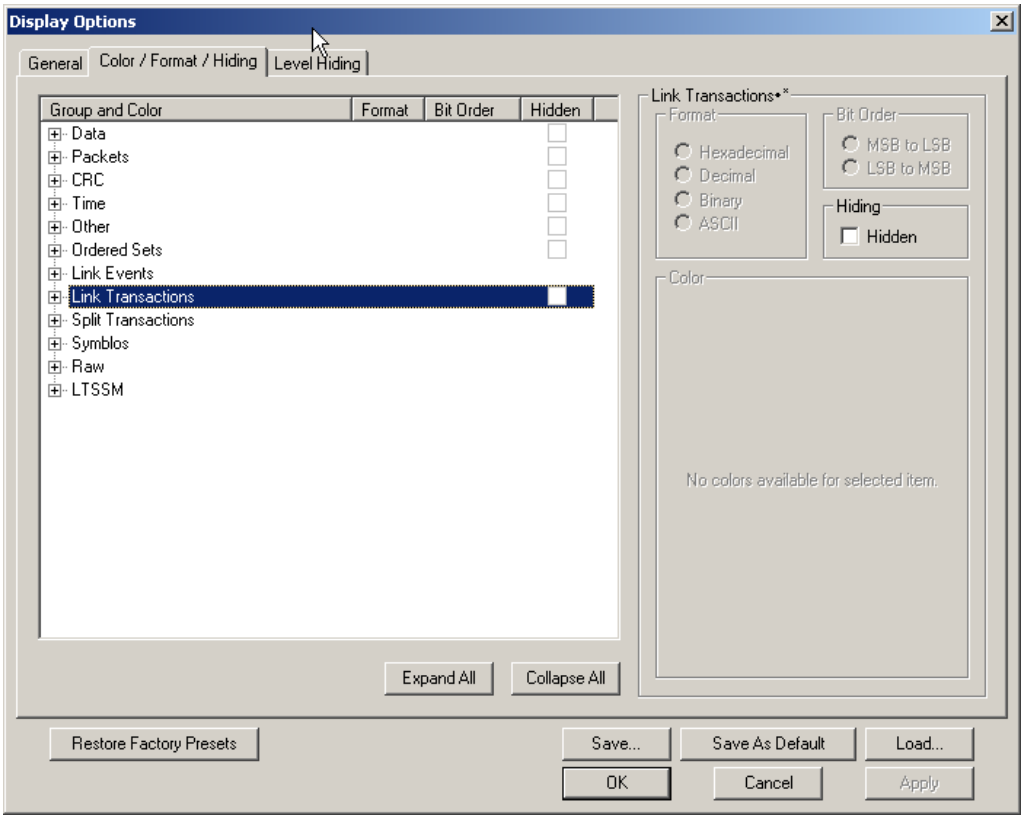
Configuration Name

Display Configuration Name: This field is used to enter a text string to be associated with the current set of Display Options. This name is saved with the Display Options file, and appears as part of the title of the packet view window that uses this set of Display Options.

7.3 Color, Format, and Hiding Options

The Color/Format/Hiding tab allows you to customize the colors and formats associated with each field in the CATC Trace and to selectively hide fields or packets. You access these display options by selecting **Setup > Display Options > Color/Format/Hiding** tab.

The Color/Format/Hiding property page lets you set how fields display in a CATC Trace. This property page lets you set field color and data format (binary, hex, decimal, ASCII), and lets you hide selected fields from the display.



Setting Field Colors

The Field Colors tab allows you to customize the colors associated with each field used in the packet view.

You may experiment with this option to achieve a color combination that suits you.

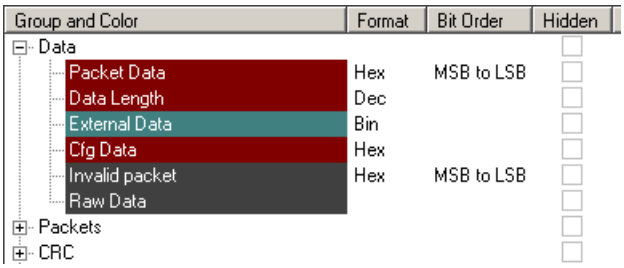
Select or change the trigger color using the color buttons labeled **- Packet #** and **+ Packet #** (before and after trigger) found under the Packet# section of the Field Colors window.

You select or change a color by clicking the appropriate color button. This action causes a color palette to pop up. Select the desired color and press OK.

Step 1 Click **View > Set Display Options** to open the Display Options dialog box.

Step 2 Select the **Color/Format/Hiding** property page.

Step 3 Under the Group and Colors column, click the **plus** symbol (**+**) next to the group you want to reformat. The group expands to show the individual fields within the group. Each field has a color, as shown below:



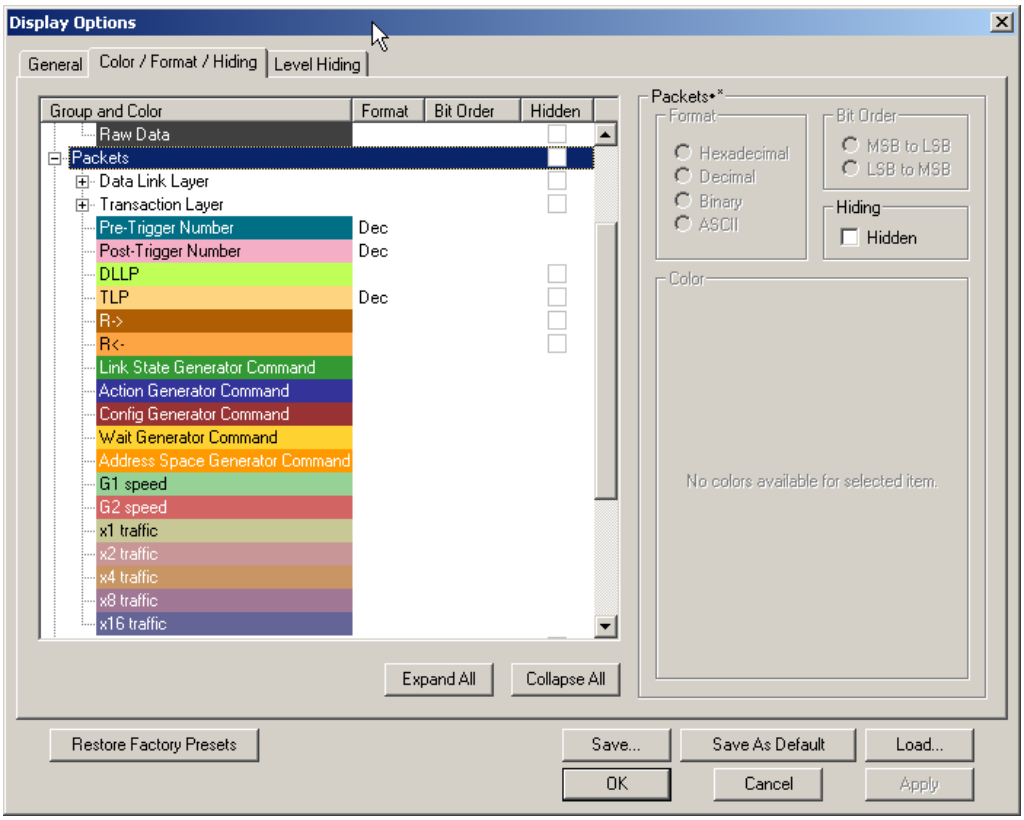
Step 4 Click the colored cell that you want to change. A color palette appears.

Step 5 Click a color in the palette, then click **Apply** or **OK**.

Note: The colors of the following Frame types cannot be changed:

- Invalid Data (frame error) field (red)
- Softbit Errors (yellow)

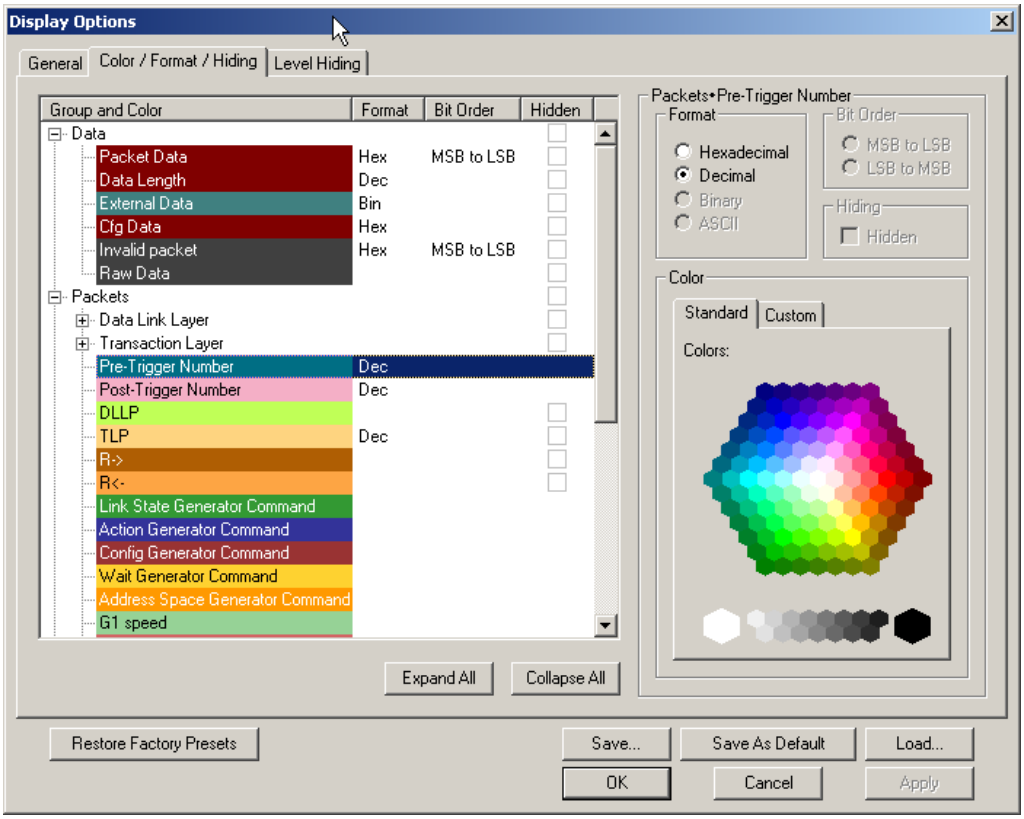
You can also change color by left-clicking a field in the CATC Trace and selecting Color from the pop-up menu.



Changing Field Formats

The Field Formats tab allows you to define the way various numeric fields are shown in the packet display. You can select Hexadecimal, Decimal, Binary, or ASCII for certain fields or groups of fields.

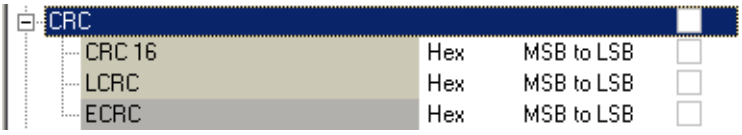
To change a field's format, click the plus sign (+) next to a field in the list. This causes the selected item to expand so you can see its constituent sub-fields. Select a sub-field, and then choose the format from the formatting choices that appear at the bottom of the window.



To change the format of alphanumeric characters in a field:

Step 1 Under the Group and Colors column, click the **plus** symbol (**+**) next to the group you want to reformat. The group expands to show the individual fields within the group (as shown above).

Step 2 Click the **row** representing the field that you want to reformat. If the field can be reformatted, the format options at the top of the dialog box become active, as shown below:



Step 3 Select a **format**.

Step 4 Specify the bit order in the displayed fields by checking/unchecking the **MSB > LSB** checkboxes.

Step 5 Click **Apply** or **OK**.

Hiding Fields

To hide a field:

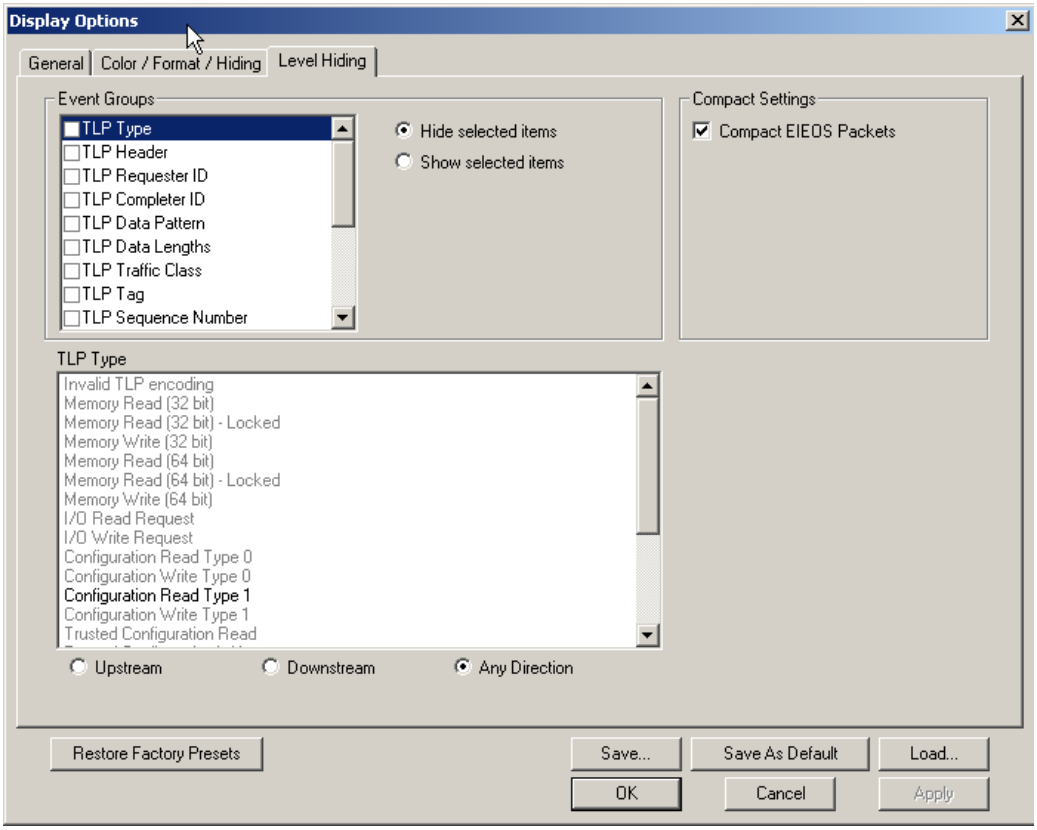
Step 1 Under the Group and Colors column, click the **plus** symbol (**+**) next to the group that has the field(s) you want to hide. The group expands to show the individual fields within the group (as shown above).

Step 2 Click the **checkbox** in the row representing the field that you want to hide.

Step 3 Click **Apply** or **OK**.

Hiding Levels

The Level Hiding page lets you hide traffic by Event Group. If you select one or more event types from the Event Group list, the selected types are hidden from the CATC Trace.



To hide a level:

Step 1 Select an Event Group.

Step 2 Select whether to **Hide** or **Show selected items**.

Step 3 Select **Upstream, Downstream**, or **Any Direction**.

Step 4 (optional) Select **Compact EIEOS packets**.

Step 5 Click **OK**.

The Event Groups for Packets are:

- TLP Type
- TLP Header
- TLP Requester ID
- TLP Completer ID
- TLP Data Pattern
- TLP Data Lengths
- TLP Traffic Class
- TLP Tag
- TLP Sequence Number
- DLLP Type
- DLLP Header
- DLLP Virtual Channel
- ACK/NAK Seq Number
- Ordered Sets
- Link Event
- Direction
- Errors

The Event Groups for Link Transactions and Split Transactions are:

- TLP Type
- Traffic Class
- Virtual Channel
- Direction
- RequesterID
- CompleterID
- Status
- Tag

7.4 Load a Previously Saved Display Options File

If you have previously saved Display Options, you can load them by opening the Display Options dialog and clicking the **Load** button. A dialog box opens to let you load a previously saved display options file.

Step 1 Click **Load** to use a previously defined display options file.

Step 2 When you see the Open File pop-up window, enter the name of the file you want to load and click **Open**.

Step 3 When the PE*Tracer*™ software returns you to the Recording Options menu, click **OK** to activate the display options you selected.

7.5 Saving Display Options

If you have customized the Display Options and wish to save them, you can do so by clicking the **Save** button, then entering a unique file name. The **.opt** extension is added by default.

Setting the Defaults: Save the currently specified Display Options to the file name: **default.opt** by clicking **Save As Default.** When the Analyzer software begins execution, it automatically loads the **default.opt** file, if one exists.

Chapter 8: Recording Options

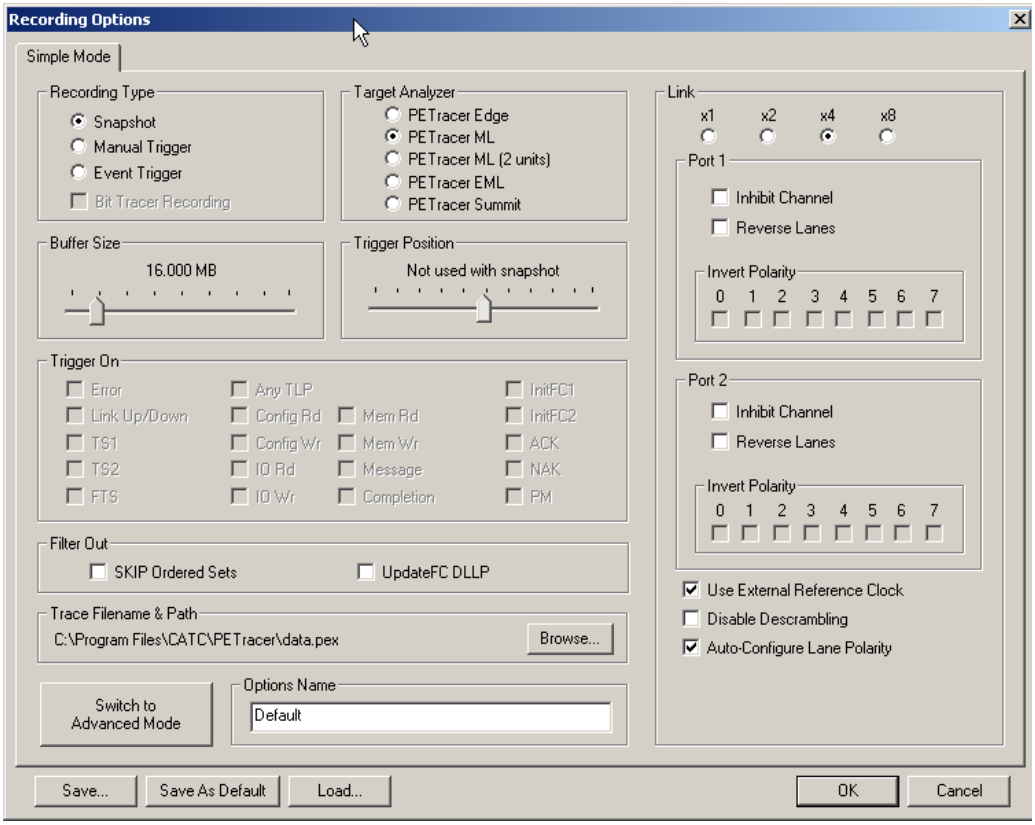
8.1 Setting Recording Options

The Recording Options dialog is used to configure a recording.

To open the Recording Options window, click or select the command **Setup > Recording Options**.

Note: There are separate sets of Recording Options for each Analyzer type. To set the Analyzer type, select the appropriate platform from the Target Analyzer menu in the General page of the Recording Options.

PE*Tracer* ML in Simple Mode:



8.2 General Tab

The General Page presents options that affect all recordings:

Recording Type: Sets the trigger mechanism for the recording: Snapshot, Manual Trigger, and Event Trigger.

Target Analyzer: Presents a menu with options for selecting an Analyzer platform:

- **PE*Tracer* Edge**
- **PE*Tracer* ML**
- **PE*Tracer* ML** (2 Units)
- **PE*Tracer* EML**
- **PE*Tracer* Summit**
- **Summit T2-16**

Buffer Size: Causes the Analyzer to record traffic to its buffer and then upload the CATC Trace to the host machine. Recordings are limited in size to the size of the Analyzer's buffer (4 GB per direction).

Trigger Position: Controls the percentage of buffer allocated for pre- and post-buffer recording.

Trigger On (Simple Mode): Error, Link Up/Link Down. TS1, TS2, FTS, Any TLP, Config Rd, Config Wr, IO Rd, IO Wr, Mem Rd, Mem Wr, Message, Completion, InitFC1, InitFC2, ACK, NAK, and/or PM.

Filter Out (Simple Mode): SKIP Ordered Sets and/or UpdateFC DLLP are provided.

Trace Filename & Path: Sets the path and CATC Trace name for the recording.

Options Name: Sets a descriptive label for the Recording Options so you can more easily recall what settings are in the Recording Options file.

Link: Settings: For link width, inhibiting recording, polarity, external reference clock, swapping recording channels, inverting link polarity, and descrambling.

Upload Size (Advanced Mode): Causes the Analyzer to upload a portion of the Analyzer's buffer. This option lets you look at part of the CATC Trace. Half of the uploaded CATC Trace is pre-buffer and half post-trigger.

Save As MultiSegment Trace (Advanced Mode): Divides the recording into segments so as to make very large recordings more easily uploaded and viewed. If you are planning to create a large recording, you might want to test this option to see how it affects performance. Large CATC Trace files are easier to navigate but slower to open.

Misc (Advanced Mode): Turns on trigger beep, sets external clocking (EML only), allows external interface signals to be saved into the CATC Trace, and tells the Analyzer to use whatever TC to VC mapping was used in the last recording (to re-use previously discovered Configuration Space data) in all future recordings. Also presents a button for manually mapping the Traffic Classes to Virtual Channels.

Recording Type

Recording Type lets you to specify the type of recording you want to make:

- **Snapshot**: A recording of a pre-determined length. You set the recording length in the Buffer Size box. Recording begins when you click the **Rec** button on the toolbar and ends when the selected buffer size is filled or when you press the **Stop** button.
- **Manual Trigger**: A recording that switches between the pre-trigger buffer and the post-trigger buffer when you push the **Trigger** button on the front of the Analyzer. Recording begins when you select **Start** in the application. Pressing the **Trigger** button causes the Analyzer to begin to finish recording. Recording continues until the post-trigger buffer has been filled. You can also end the recording by pressing the **Stop** button in the application.
- **Event Trigger**: A recording that switches between the pre-trigger buffer and the post-trigger buffer when it is triggered by an event in the CATC Trace. An Event Trigger begins when you select **Start** in the application and ends when the specified triggering event occurs in the CATC Trace or you press **Stop**. If an event triggers the end of the recording, the Analyzer records a predefined amount of post-trigger data (specified by Trigger Position and Buffer Size.)

  Note: You can also terminate an Event Trigger recording by pressing the Manual Trigger button on the front of the Analyzer. When the Manual Trigger button is pressed, the Analyzer continues to record until the specified post-trigger buffer has been filled.

Buffer Size

The Buffer Size slide-bar allows you to set the size of the recording buffer.

For PE*Tracer* ML, the size of this buffer is adjustable from 1.6 MB to 2 GB.

Note: Size selection is per direction. For example, selecting 32 MB creates two memory areas of that size.

After you have set the Buffer Size, you must set the Recording type and Trigger position options. These options determine how the buffer is used.

Note: The Buffer Size slide-bar does not precisely portray the buffer size because of the way the packets are stored in the Analyzer's memory.

Target Analyzer

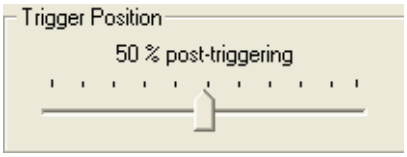
Target Analyzer presents a menu with these choices:

- **PE*Tracer* Edge**: Displays the options for the PE*Tracer* Edge Analyzer.
- **PE*Tracer* ML**: Displays the options for the PE*Tracer* ML Analyzer.
- **PE*Tracer* ML** (2 Units): Displays the same options as PE*Tracer* ML but lists **Unit 1** and **Unit 2** in the Link Section on the right. In a two-unit setup, **Unit 1** and **Unit 2** are two separate Analyzers linked together by BNC on the back of the units to form a single, logical Analyzer. The cabling for a two-unit setup is described in “Connecting the PETracer ML Analyzer to the Device Under Test” on page 31.
- **PE*Tracer* EML**: Displays the options for the PE*Tracer* EML Analyzer.
- **PE*Tracer* Summit and Summit T2-16**: Displays the options for the PE*Tracer* Summit or Summit T2-16 Analyzer.

Selecting an Analyzer platform changes the options presented in the Link and Events pages within the Recording Options dialog.

Trigger Position

This Trigger Position slide-bar lets you to adjust the amount of recording buffer allocated to recording pre-trigger and post-trigger traffic.



For example, if you set the Trigger Position to 90% Post-Triggering Traffic, the Analyzer records 10% pre-trigger traffic and 90% post-trigger traffic.

Trigger Position is only available when Manual Trigger or Event Trigger is selected.

Trigger On

In Simple Mode, Trigger On allows you to select: Error, Link Up/Link Down. TS1, TS2, FTS, Any TLP, Config Rd, Config Wr, IO Rd, IO Wr, Mem Rd, Mem Wr, Message, Completion, InitFC1, InitFC2, ACK, NAK, and/or PM.

Trace Filename and Path

The Trace Filename and Path button on the Recording Options General panel allows you to change the default file name and path for the recorded CATC Trace file. The pre-defined name is **data.pem**.

Step 1 Select the **Recording File Name** button.

Step 2 When you see the **Save As** menu, navigate to the directory you want.

Step 3 Enter the new file name in the File name field.

Step 4 Click the **Save** button.

This action does not do any immediate save operation. It just changes the default name and uses it in subsequent recordings.

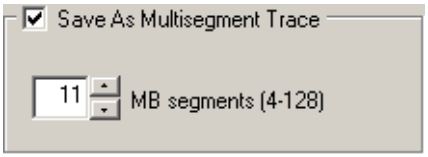
Options Name

The Options Name is a descriptive, supplemental label that you can assign to a Recording Options file.

For example, if your Recording Options file were named **StandardSettings.rec**, your Options Name could be a long descriptive label such as **Standard Record Options used for all normal Recordings**.

Save As MultiSegment Trace

This option causes the Analyzer to segment the CATC Trace into 4 MB to 128 MB files and to create an index file that summarizes the starting and finishing frame for each segment.



The index file has a default name of **data.pem**.

The index file and segmented CATC Trace files are stored in a directory named **data_pem_files**. The directory is named after the index file. Below this directory additional, sequentially numbered sub-directories (up to 10,000) hold the segmented CATC Trace files. These sub-directories bear simple numerical names: 00000 to 00999. Each of these subdirectories can hold up to 100 sequentially numbered segment files.

Example

A 1010 MB recording using the default file names creates the following sub-directories and files:

`data.pem` (This is the index file.)

```
data_pem_files\00000\segment_00000.pex
data_pem_files\00000\segment_00001.pex
...
data_pem_files\00000\segment_00099.pex
data_pem_files\00001\segment_00100.pex
data_pem_files\00001\segment_00101.pex
```

The index file looks something like a CATC Trace file but contains packet-like entities that summarize each segment.

Viewing Multisegmented Files

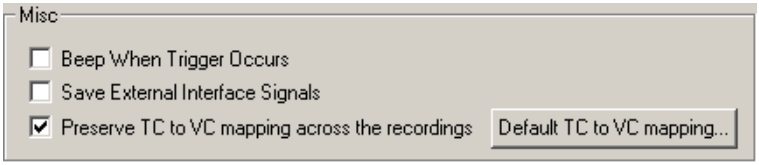
If Save As MultiSegment Trace is enabled in the General page of the Recording Options, PE*Tracer* divides the CATC Trace into segments and stores them on the host machine's hard drive. Segment size is set in the MB Segments box. Enter a value from 4 MB to 128 MB.

PE*Tracer* also creates an index file that provides a brief summary of each segment and hyperlinks to each of the segments. Double-clicking a segment summary in the index file causes PE*Tracer* to open that segment.

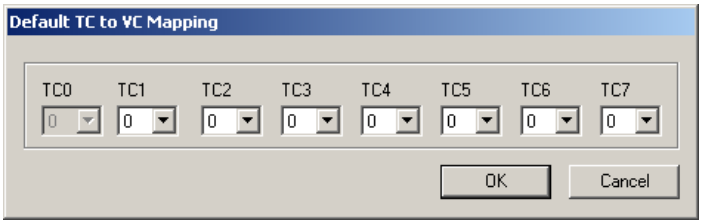
You can also navigate through the segments by clicking the buttons on the Multisegment toolbar.

Misc

Allows you to specify the following parameters for recording and uploading traffic:


Misc
Beep When Trigger Occurs
Save External Interface Signals
Preserve TC to VC mapping across the recordings
Default TC to VC mapping...

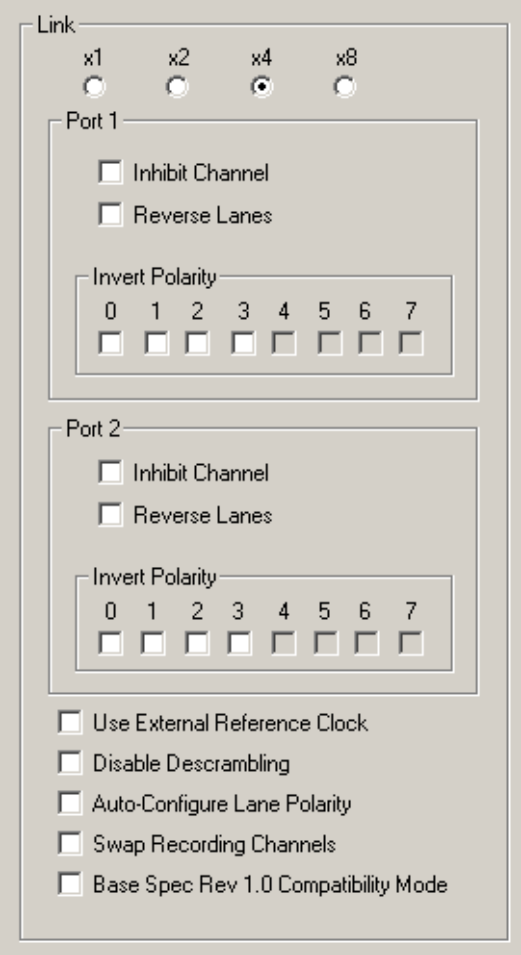
- **Beep When Trigger Occurs**: Causes the Analyzer to beep when a trigger event is detected.
- **Save External Interface Signals**: If selected, causes the Analyzer to save signals from a Breakout Board as fields in the CATC Trace.
- **Preserve TC to VC mapping across the channels**: Causes the Analyzer to use whatever TC to VC mapping it established in the last recording.
- **Default TC to VC mapping button**: Lets users manually configure the default mapping.



Link for PE*Trainer* ML

The Link section allows you to manage links:

PE*Tracer* ML



Link Width: Sets the physical width of the link.

Port 1 (Unit1) and Port 2 (Unit 2): Gives you low-level control over each link direction. The heading for these boxes indicates the port and/or unit to which the following options are applied based on the current Analyzer configuration:

- **Inhibit Channel**: Prevents recording on the selected link direction.
- **Reverse Lanes**: Causes the Analyzer to reverse the lane order for this link direction. For example, if you are working with a PCI Express™ device that uses a 3 2 1 0 lane order instead of a 0 1 2 3 order or uses a 0 to 15 lane order instead of a 15 to 0 order, you select this option to enable the Analyzer to match the order of the device. **Note:** If reversing lanes for a PE*Tracer* ML x8 link, the Port 1 and Port 2 cable connections for the link must also be swapped.
- **Invert Polarity**: Inverts the d+ and d- polarity for each specified lane. If for some reason the d+ on one side of a link is wired to the d- on the other side (or vice versa), then selecting Invert Link Polarity corrects for that condition.

Use External Reference Clock: If the PCI Express link under analysis uses spread-spectrum clocking, then the Analyzer must use the external reference clock from the host machine. If host machine does not supply a reference clock, the internal reference clock in the Analyzer module is used instead for link analysis.

Disable Descrambling: If checked, causes the Analyzer to assume that none of the PCI Express traffic is scrambled. By default, the Analyzer determines the scrambling state of the devices under test.

Auto-Configure Lane Polarity: Lets the Analyzer determine lane polarity.

Base Spec 1.0 Rev Compatibility Mode (Advanced Mode): This option causes the Analyzer to conform to the PCI Express 1.0 Specification.

Swap Recording Channels (Advanced Mode): Swaps upstream/downstream assignments. Normally, the software makes upstream and downstream assignments based on Configuration Requests within the CATC Trace. Sometimes these requests are not captured. You can manually re-assign channels using this checkbox.

Saving and Loading Previously Saved Recording Options

The options are:

Save: Saves the current options to whatever file name you provide.

Save As Default: Saves the current options into the default options file. This file is called **default.rec** or whatever other name you have assigned to the default options file. Whenever the Teledyne LeCroy PE*Tracer* software begins execution, it automatically loads the default file, if one exists.

Load: Loads a previously saved set of recording options.

OK: Applies changes and closes the Recording Options dialog box.

Cancel: Cancels changes and closes the Recording Options dialog box.

Loading Recording Options

In the Recording Options menu, you can load a previously saved recording options file.

To load Recording Options:

Step 1 Select **Setup > Recording Options** from the menu.

Step 2 Click the **Load** button from the Recording Options dialog box. The Load dialog opens and lists previously saved options files (***.rec**).

Step 3 Select a file and click **OK**. The options file loads.

Saving Recording Options

Recording Options settings can be saved and later reused. Recording options settings are stored in ***.rec** files.

Step 1 Open the Recording Options dialog by selecting **Setup > Recording Options.**

Step 2 Set your options, then click **Save**.

Step 3 Enter a unique file name. The **.rec** extension is added by default.

Step 4 (optional) To add a descriptive label to this file to help you remember what options were set, use the **Options Name** box.

Setting Default Recording Options

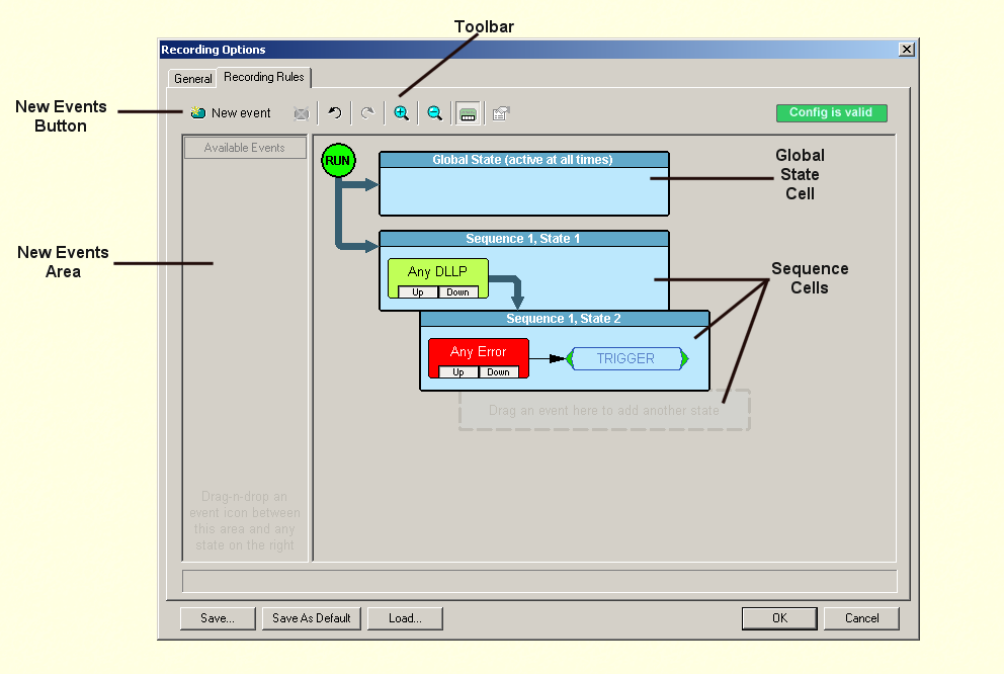
To save the current recording options into the default Recording Options file:

- Click **Save As Default**.
  The default file for the options is **default.rec**.

  When the PE*Tracer* software begins execution, it automatically loads the **default.rec** file, if one exists.

8.3 Recording Rules Overview

The Recording Rules page lets you to set triggers and filters.



The page divides into three areas:

Toolbar: Contains buttons such as the New Events button for issuing commands.

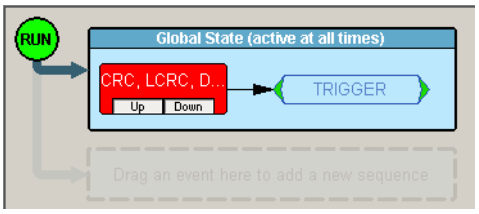
Available Events area: A part of the screen where you can park buttons that you intend to use in the Main display area.

Main display area: The part of the screen where you create trigger and filter conditions. You create conditions by dragging buttons onto the Main display area from the Available Events area. You then create additional conditions by right-clicking a button and selecting options from a pop-up menu. See Creating Recording Rules.

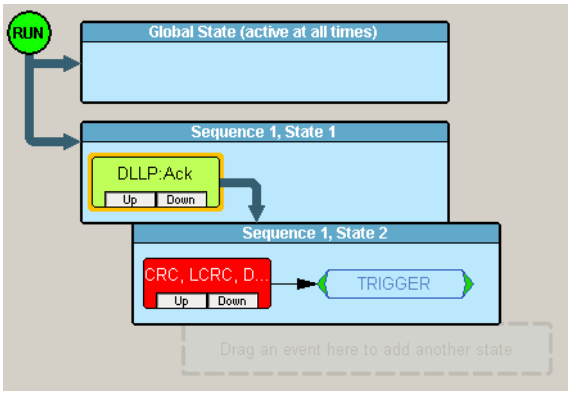
Global State vs. Sequences

The Main Display area in the center of the Recording Rules page has two cells that affect events differently.

Global State: Events dragged into the Global State cell are searched for throughout the recording. For example, if you place an Error in the Global State cell and assign a Trigger to it, the Analyzer searches for errors from the start of the recording until the end.



Sequence State: The cell marked **Drag an event here to create a new sequence** is a Sequence Cell. Sequence cells are used to event sequences, which are chains of events culminating in a trigger or other action. One sequence (i.e., a separate chains of events) can be created with up to 32 states. A state is an event condition plus some action within a sequence.



8.4 Recording Rules Buttons

The Recording Rules toolbar allows you to create and edit recording rules:

New event	New Event. Opens a drop-down menu with a list of events.		Zoom in
	Delete. Delete selected event.		Zoom out
	Undo. Undoes last action.		Show/Hide Channels. Shows/hides the channel buttons.
	Redo. Undoes last Undo command.		Show properties. Opens the Properties dialog box for the selected item.

8.5 Creating Recording Rules

The Recording Rules page is used to set triggers and filters. To access this page, select **Setup > Recording Options > Recording Rules**.

There are three steps to creating a recording rule:

1) Select events.

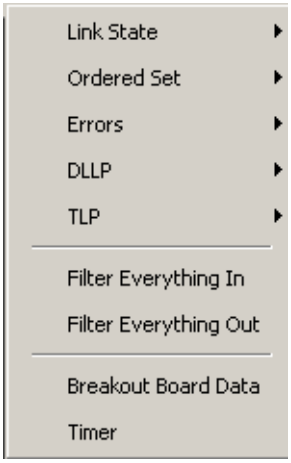
2) Place the events in the Global State or Sequence cells.

3) Assign actions to the events.

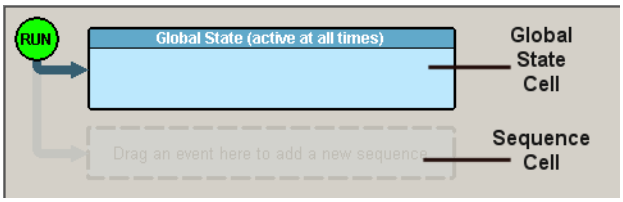
Note: There are limits to the types of rules that can be created. See “Recording Rule Limits” on page 132 for details.

Step 1 Click

and select one or more events from the menu. Selecting an event automatically places it in the Available Events area. This area serves as a parking lot where you can place event buttons without them having any effect on the Analyzer.



Step 2 Drag the selected events from the Available Events area into one of either the Global State cell or the Sequence cell (see “Global State vs. Sequences” on page 128):

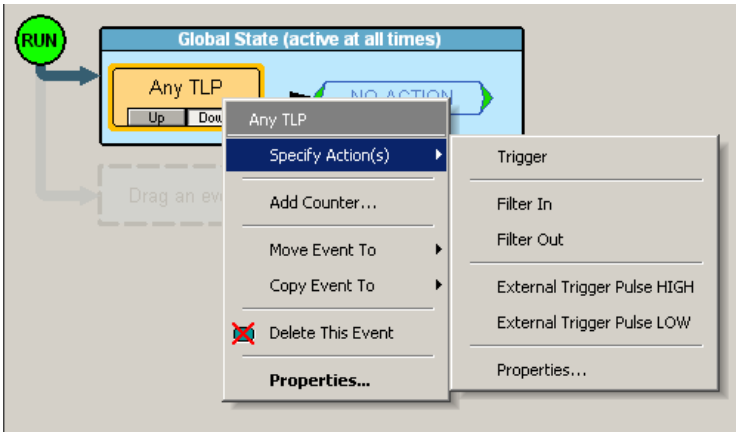


Global State Cell: If you want the Analyzer to always search for the event, place it in the cell marked **Global State**.

Sequence Cell: To create an event sequence, place two or more events in the faintly marked cell that reads **Drag an event here to create a sequence**. At this point, the selected events have no effect because an action has not been assigned.

Step 3 To select a sub-set of your selected event, right-click it and choose **Properties**. A Properties dialog box opens that presents additional options. For example, if you open the Properties dialog for Errors, you can set the specific types of errors the Analyzer should look for.

Step 4 Assign an action to the selected events by right-clicking each of the events, selecting **Specify Action** from the pop-up menu, and assigning an action such as **Trigger, Filter**, or **Count**. Be sure to click the event itself and not the **State** cell that it is sitting in (which produces a different pop-up menu.)



Note: You can also assign actions to events by double-clicking the event and selecting the Actions page when the Properties dialog box opens.

Step 5 Click **OK** to close the dialog box. At this point, assuming that the other options in the Recording Options dialog box have been set (such as the General page), you can begin the recording by pressing the

Start **Recording** button.

8.6 Recording Rule Limits

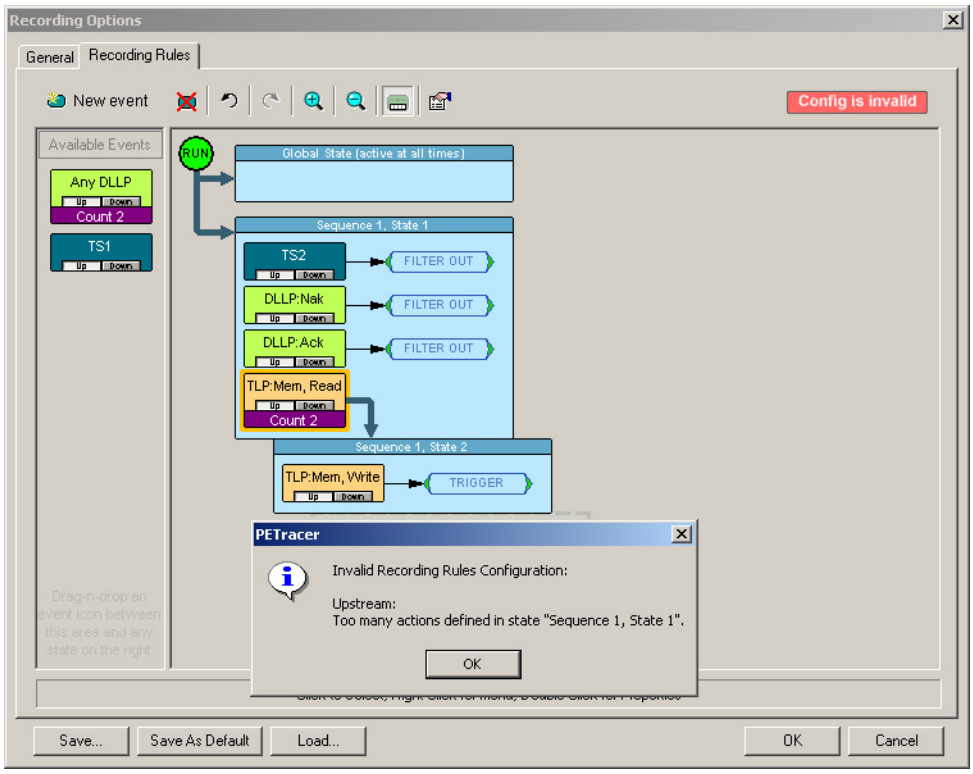
PE*Tracer* ML has finite buffer resources that limit the number of actions and events that can be assigned for each recording channel. When creating complex event sequences, it is possible to hit the limits of these resources and get an error message like the ones shown in the screenshots below.

In addition to the following limitations, you should also be aware of how PE*Tracer* handles user-created contradictory rules. See “Recording Rules Logic: How Contradictory Rules are Resolved” on page 134 for an explanation.

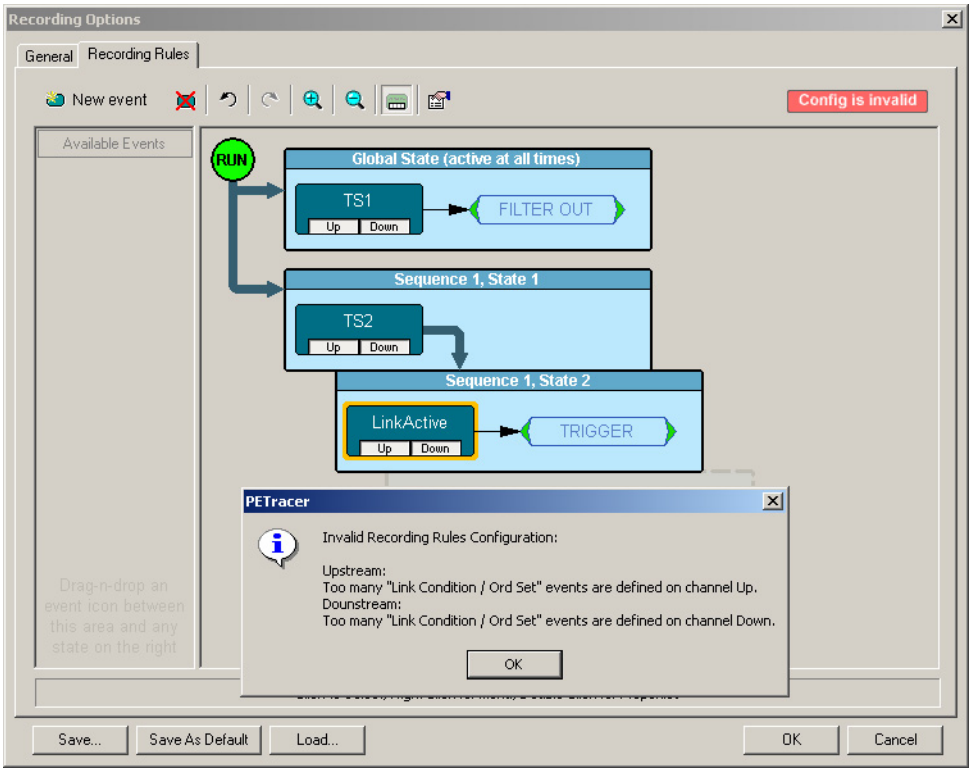
In order to maximize the buffer allocation for recordings, Teledyne LeCroy has imposed the following configuration limitations into PE*Tracer* ML.

Configuration Limitations in PE*Tracer* ML

- **Up to four actions per state**: No more than four actions can be assigned per state or the error message shown below appears and the Status Indicator in the top right of the dialog generates an **Invalid Configuration** status.
  Example: Too many Actions per State. In this example, the actions are: three Filter Outs, an Advance the Sequence, and a Count.



- **Up to two sets of Link Conditions or Ordered Sets per channel**: If you place a combination of three Link Conditions and Ordered Sets into three separate state cells and then assign three different actions to each, an error results.
  Example: Place TS1 in the Global State cell and select **Filter Out**. Then place TS2 in **Sequence 1, State 1** and select **Advance the Sequence**. Then add Link Active to **Sequence 1, State 2** and select **Trigger**. When you attempt to apply **Trigger** to **Link Active**, an error message appears.
  Example: Too many Link Conditions and Ordered Sets. In this example, the user attempted to create a rule with three Link Conditions and Ordered Sets. The maximum allowable Link Conditions and Ordered Sets is two.



- **In two-unit setups, no cross-box sequencing is allowed**: For example, you cannot configure the first Analyzer to advance sequence on TLP and then configure the second to trigger on a DLLP-ACK for this TLP. Actions apply to both Analyzers.
- **Four different DLLPs per channel**
- **Three different TLPs per channel**
- **Four payload DWORD-checkers per channel**
- **One set of errors per channel**
- **One Timer event per channel**
- **Two Counters per channel**

8.7 Recording Rules Logic: How Contradictory Rules are Resolved

When creating rules in the Recording Rules page, it is possible to create contradictory instructions such **Filter Anything Out** and **Filter Anything In**. To resolve such conflicts, the Recording Rules page implements three internal rules that are described here:

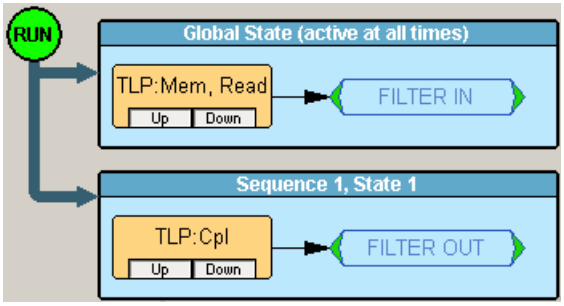
- Rules created in Sequence cells have a higher priority than rules created in the Global State cell: If a rule is placed in a Sequence cell, and a contradictory rule is placed in Global State cell, the rule in the Sequence cell applies.
- Filter-In has a higher priority than Filter-Out, so when a Filter-In rule is placed inside the same state as Filter-Out rules, only the Filter-In rule applies.
- Filter-In Anything and Filter-Out Anything have the highest priority and override any other filtering rules, so when Filter-In Anything or Filter-Out Anything are placed in the same state cell as other Filter rules, only the Filter-In Anything or Filter-Out Anything rules apply.

Recording Rules Examples

Read through the following examples to better understand how the three rules apply.

Note: In addition to these three rules, the Recording Rule Limitations define the **upper limits** of rule creation. These limitations should not affect you, but you should be aware of them.

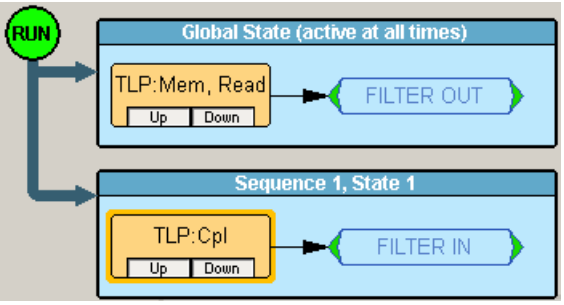
Example 1



Result: Only TLP:Mem,Read is in the CATC Trace.

Reason: The Sequence rule Filter out TLP:Completion is not contradicting the global state rule to filter in TLP:Memory. Both rules are applied.

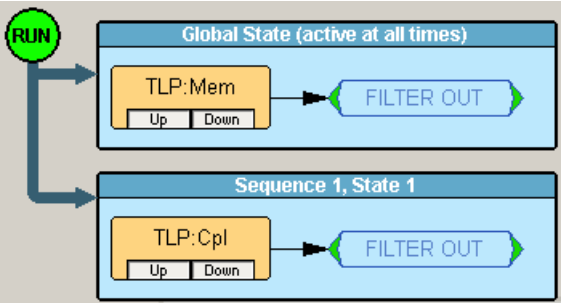
Example 2



Result: Only TLP:Completion is in the CATC Trace.

Reason: The sequence rule to filter in TLP:Completion is not contradicting the global state rule to filter out TLP:Memory. Both rules are applied.

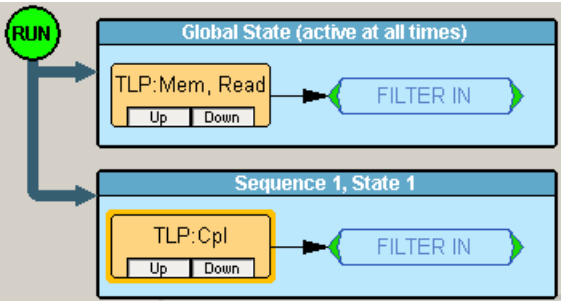
Example 3



Result: TLP:Completion and TLP:Memory are filtered out.

Reason: The Sequence rule to filter out TLP:Completion is not contradicting the global state rule to filter out TLP:Memory. Both rules are applied.

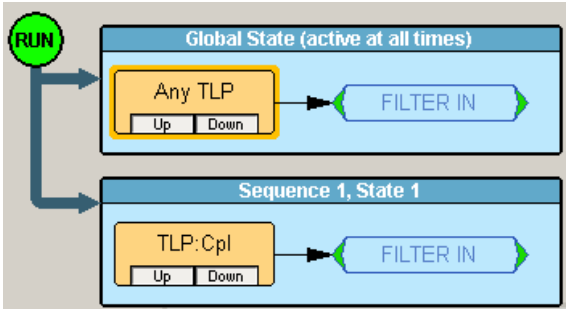
Example 4



Result: Only TLP:Completion and TLP:Memory are in the CATC Trace.

Reason: The sequence rule to filter in TLP:Completion is not contradicting the global state rule to filter in TLP:Memory. Both rules are applied.

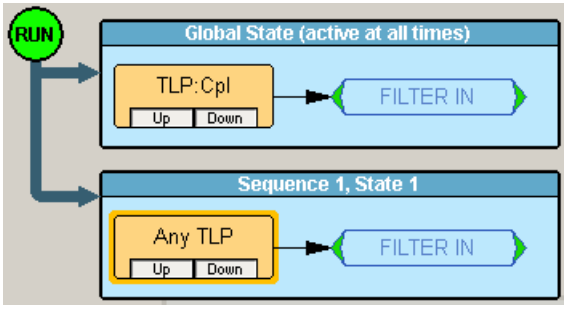
Example 5



Result: Only TLP (any type) is in the CATC Trace.

Reason: The sequence rule to filter in TLP:Completion is not contradicting the global state rule to filter in Any TLP. Both rules are applied.

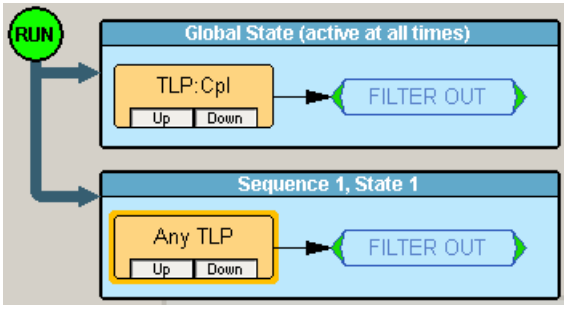
Example 6



Result: Only TLP (any type) is in the CATC Trace.

Reason: The sequence rule to filter in Any TLP is not contradicting the global state rule to filter in TLP:Completion. Both rules are applied.

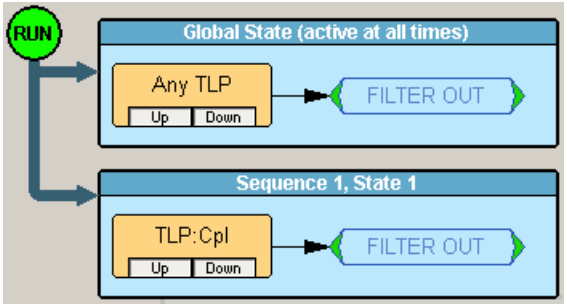
Example 7



Result: All TLP are filtered out.

Reason: The sequence rule to filter out Any TLP is not contradicting the global state rule to filter out TLP:Completion. Both rules are applied.

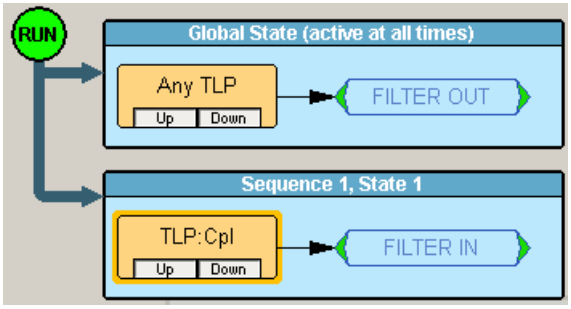
Example 8



Result: All TLP are filtered out.

Reason: The sequence rule to filter out TLP:Completion is not contradicting the global state rule to filter out Any TLP. Both rules are applied.

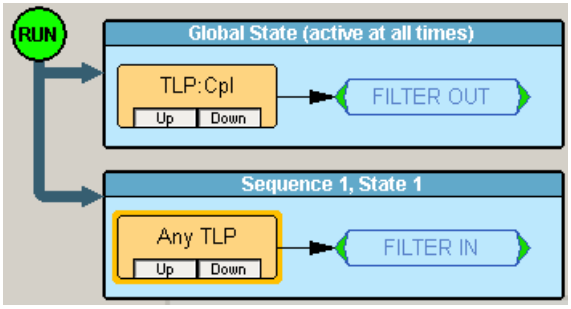
Example 9



Result: Only TLP:Completion is in the CATC Trace.

Reason: The sequence rule to filter in TLP:Completion is overwriting the global state rule to filter out Any TLP.

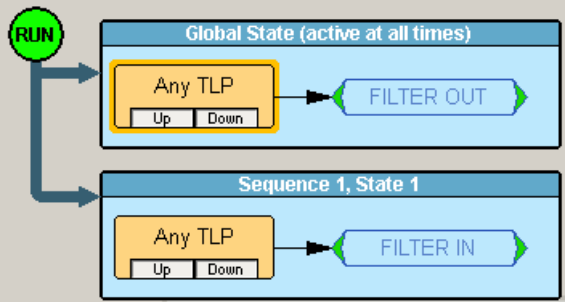
Example 10



Result: Only TLP (any type) is in the CATC Trace.

Reason: The sequence rule to filter in Any TLP is overwriting the global state rule to filter out TLP:Completion.

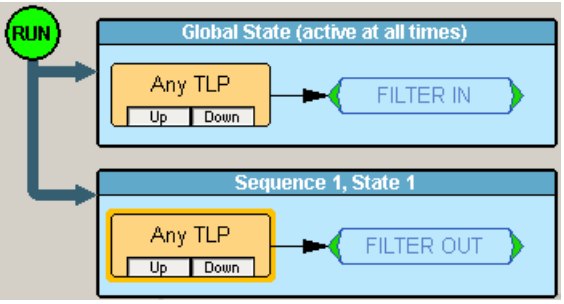
Example 11



Result: Only TLP (any type) is in the CATC Trace.

Reason: The sequence rule to filter in Any TLP is overwriting the global state rule to filter out Any TLP.

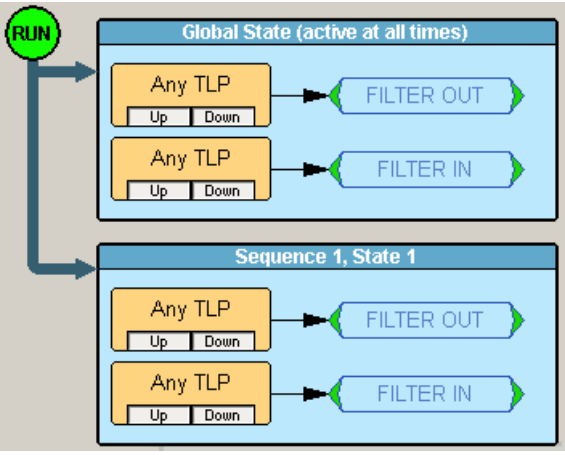
Example 12



Result: Empty CATC Trace.

Reason: The sequence rule to filter out Any TLP is not contradicting the global state rule to filter in Any TLP. Both rules are applied. (The global rule filters out DLLPs and Ordered Sets, and the sequence rule filters out TLPs.)

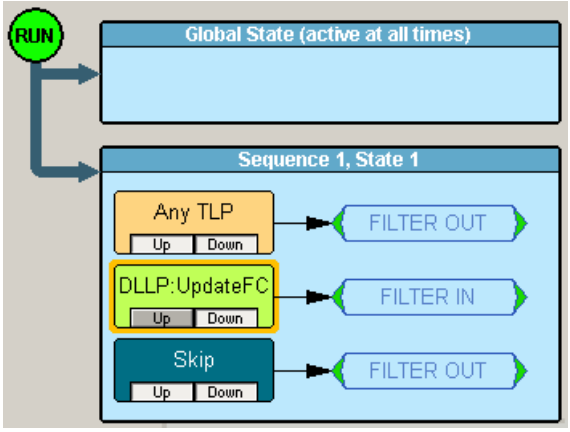
Example 13



Result: Only TLP (any type) is in the CATC Trace.

Reason: Filter out rules in the global state cell and in the sequence state cell are ignored. The Filter-In Any TLP rule is used.

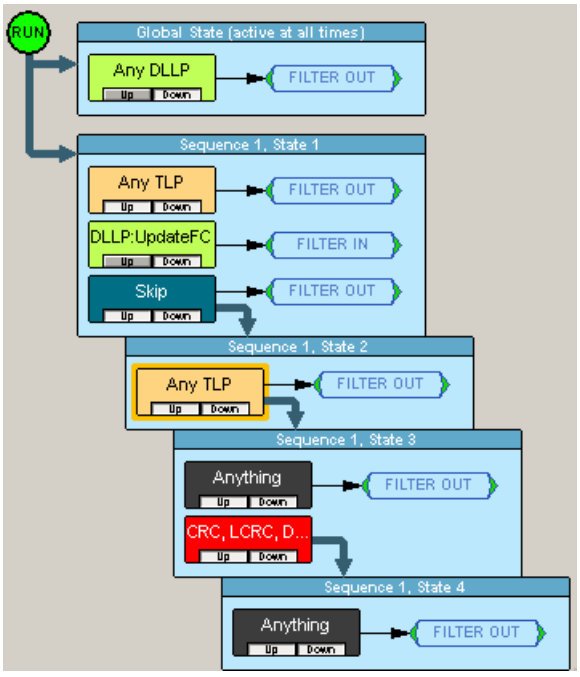
Example 14



Result: Only DLLP:UpdateFC is in the CATC Trace.

Reason: The Filter out rules are ignored. Filter in DLLP:updateFC rule is used.

Example 15



While in state 1: Only DLLP:UpdateFC is in the CATC Trace.

Reason: The Filter out rules are ignored. Filter in DLLP:updateFC rule is used.

While in state 2: Only Ordered Sets are in the CATC Trace.

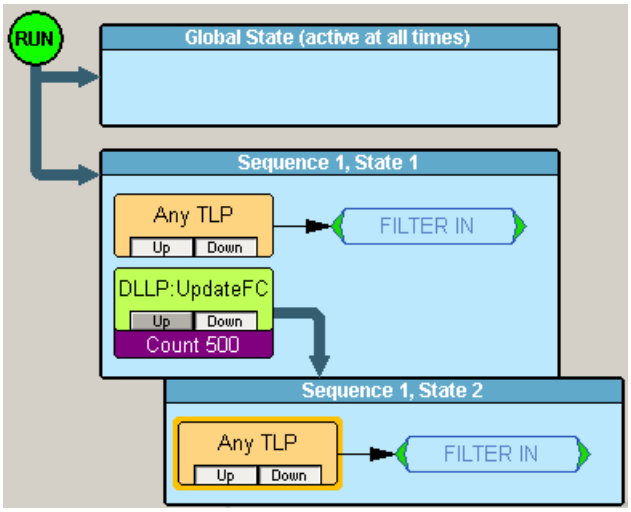
Reason: Both the sequence state and the global state rules are used, and all TLPs and DLLPs are filtered out.

While in state 3: Nothing is recorded.

While in state 4: Everything is recorded.

Reason: The sequence state rule to filter in anything overwrites global state rule.

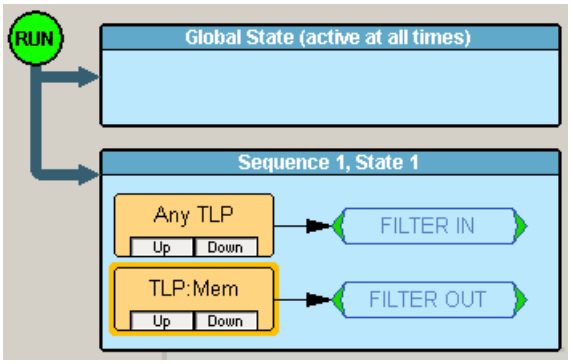
Example 16



Result: Only TLP (any type) is in the CATC Trace.

Reason: In both states, the rule is to keep only TLP.

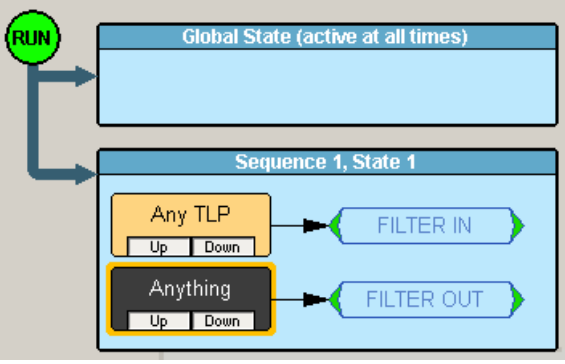
Example 17



Result: Only TLP (any type) is in the CATC Trace.

Reason: The Filter-out rule is ignored because there is a filter-in rule with a higher priority.

Example 18



Result: Empty CATC Trace.

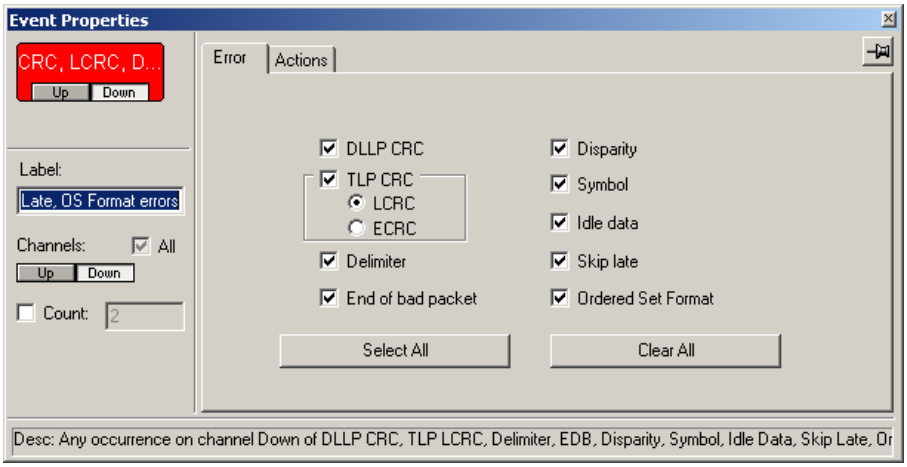
Reason: Filter Anything has the highest priority and overwrites filter-in rule.

8.8 Properties Dialog Boxes

Properties dialog boxes provide additional settings for Events, States, Actions, and other objects in the Recording Rules page. You can access a Properties dialog by double-clicking an **Event, State, Action** or other object.

8.9 Event Properties Dialog

The Event Properties dialog presents options for refining triggers and filters. For example, to set a trigger on a specific type of error, you open the Properties dialog



Accessing the Properties Dialog

To see the Properties dialog, first create an event button by clicking the **New Events** button and choosing an event from the menu. Afterwards, open the Event Properties dialog by doing one of the following:

- Double-click an event.
- Right-click an event and select **Properties** from the pop-up menu.
- Click the **Properties** button on the toolbar.

Dialog Settings and Features

Event Icon Preview: This icon shows you which event properties you are editing. The Icon Preview looks exactly like the icon in the Main Display area.

Icon Label: A text box for labeling the button. Whatever you type here appears on the button.

Channels: These controls allow you to select the channel(s) that the Analyzer should search when it is looking for the event.

Count: A counter tells the Analyzer to search for *x* instances of the selected event. For example, if you enter **10**, the Analyzer counts 10 instances of the selected event before it performs whatever action you assign. There are only two counts available in the hardware so if you try to assign more than two, you get a warning. Counters cannot be applied to events with Filter Actions. The maximum counter value is 65,535.

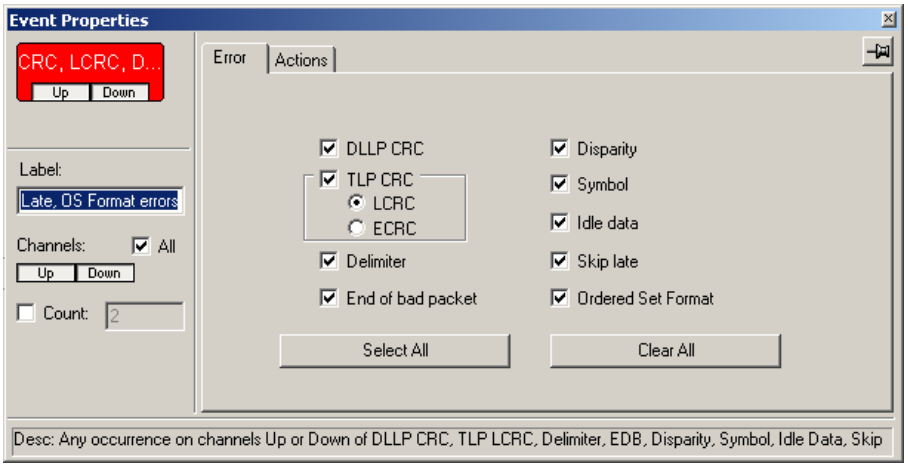
Pin Button: Allows you to **pin** the Properties dialog box to the application so that it does not go away when another object appears such as an event, state or action.

Description String: This area contains a textual description of the event.

Event-specific Settings: The largest part of the Event Properties dialog box. The settings in this area vary for different events. Some events do not have any additional settings (for example, Basic Link Services, Extended Link Services). The Events that do have settings are: Error Event, Data Frame Event, Primitive Event, Advanced Primitive Event, SCSI Command Event, Breakout Board Event, and Timer Event.

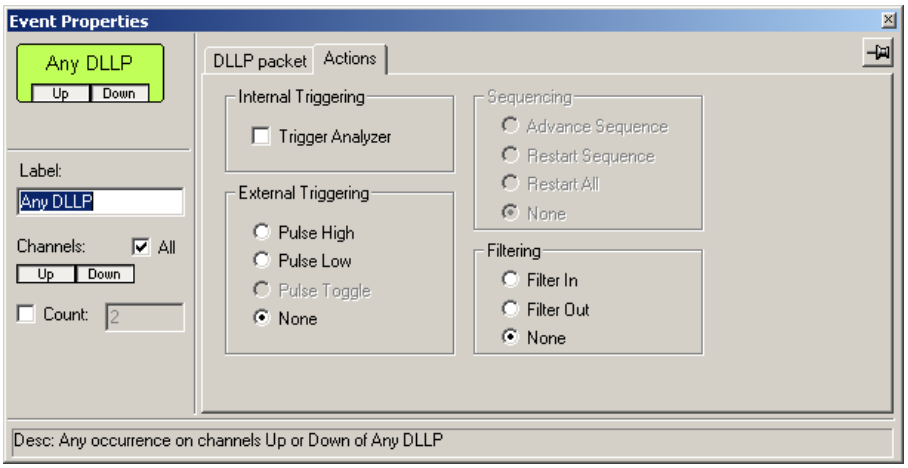
Error Properties Dialog

The Error Properties dialog box lets you select specific error types for performing an action. There are two sets of Error types: Packet Errors and Idle Errors.



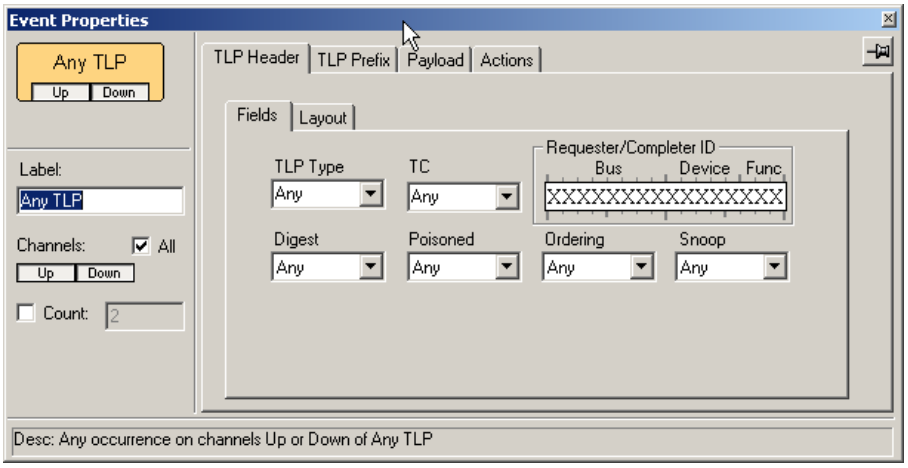
Actions Properties Dialog

The Actions Properties dialog box.



TLP Header Properties Dialog

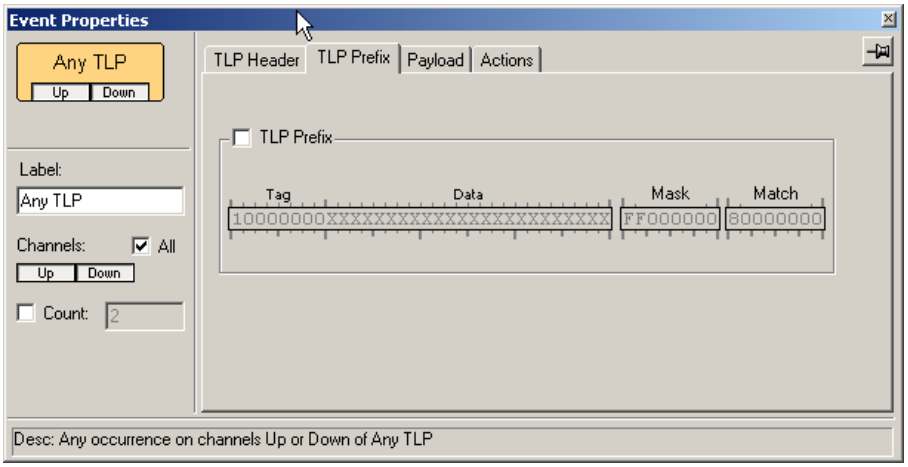
The TLP Header Properties dialog box.



Note: TLP Prefix is available only on Summit T2-16.

TLP Prefix Properties Dialog

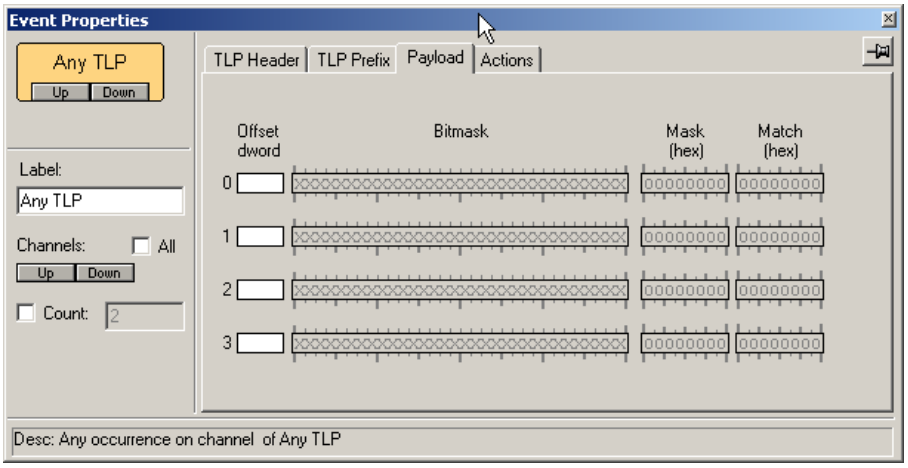
The TLP Prefix Properties dialog box.



Note: TLP Prefix is available only on Summit T2-16.

Payload Properties Dialog

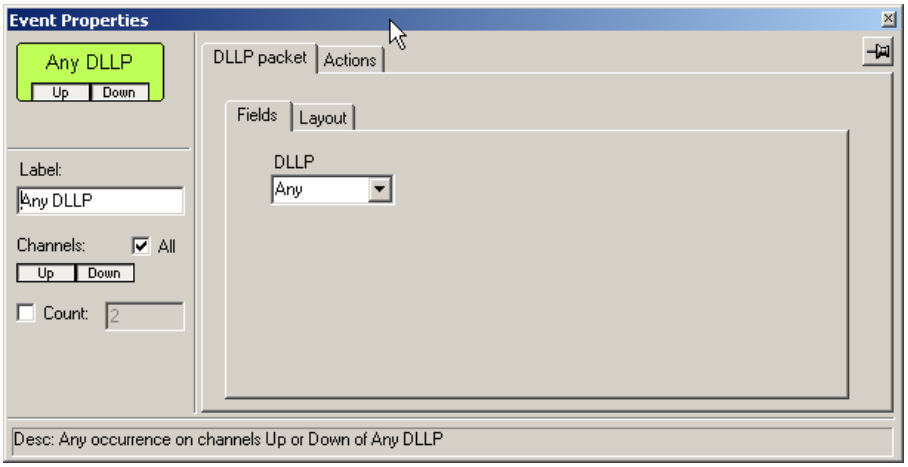
The Payload Properties dialog box.



Note: TLP Prefix is available only on Summit T2-16.

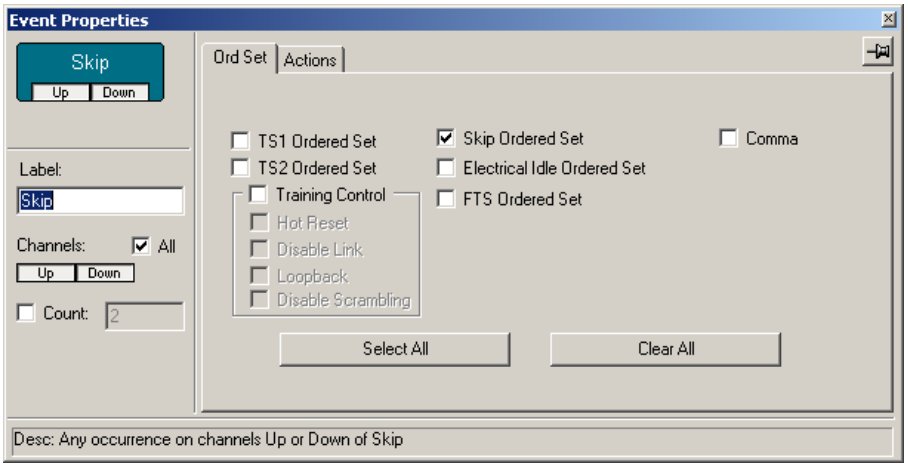
DLLP Packet Properties Dialog

The DLLP Packet Properties dialog box.



Ordered Set Properties Dialog

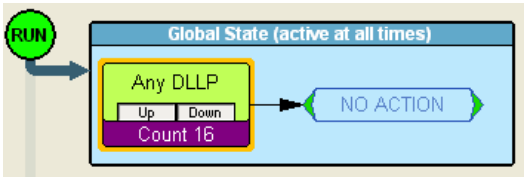
The Ordered Set Properties dialog box.



8.10 Counting Events

Triggers can be set on multiple instances of an event. For example, you can set a trigger to occur following five instances of any DLP. To configure the Analyzer to look for multiple events, you enable **Counters**. Counters tell the Analyzer how many occurrences of an event it should wait for before triggering.
For example, **Trigger following the 16th occurrence of an error**.

Counters enable triggers to be set that are based on a count of events. For example, you could use a counter to **Trigger following the 16th occurrence of a DLLP message**



To use a counter, follow these steps:

Step 1 Click an event. This causes an arrow to appear.

Step 2 Click one of the two counters (it does not matter which you use). This causes the counter to attach itself to the bottom of the event (shown above). An arrow automatically connects the counter to the Trigger button.

To change the counter value:

Step 1 Click the small blue dot in the upper-left corner of the counter button. A menu appears.

Step 2 Select **Change Counter Value**.

Step 3 Enter a new value in the pop-up dialog box. This causes the new value to appear in the counter button.

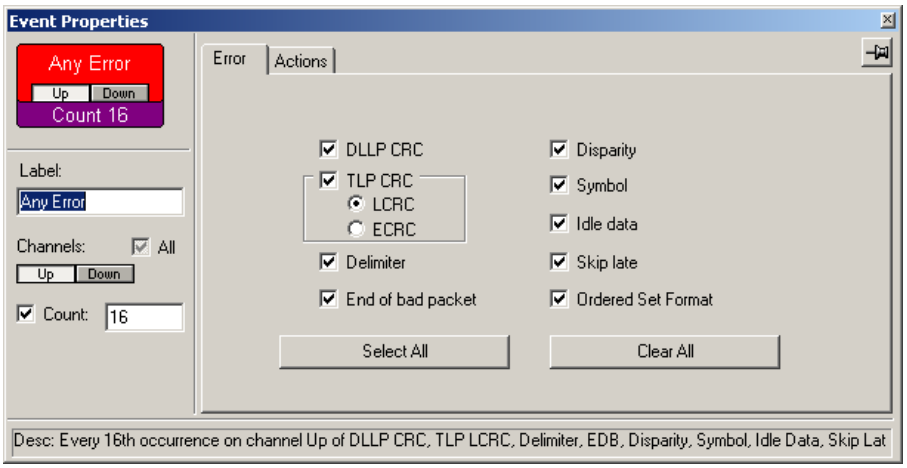
How to Set a Counter

To set a counter:

Step 1 Open the Recording Rules page, select an event, and drag it to the **Global State** or **Sequence** cells. For details on these steps, see “Creating Recording Rules” on page 129.

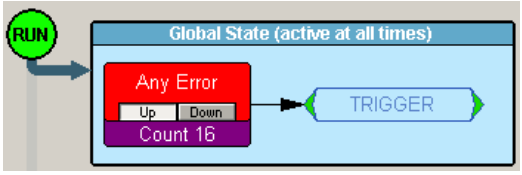
Step 2 Counts can only be set on a per channel basis, so press the **Up** or **Down** channel buttons to select the channel on which the count is performed.

Step 3 Right-click the selected event and select **Add Counter** from the menu to open the Properties dialog.



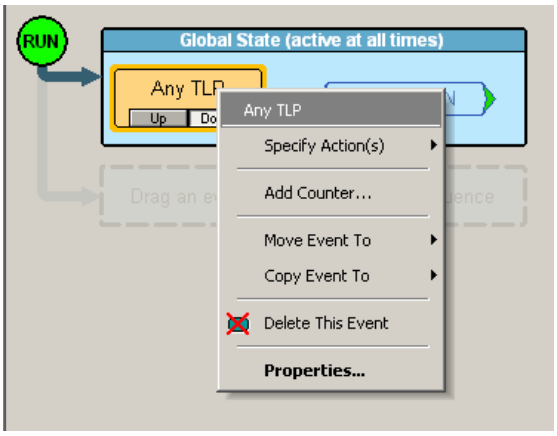
Step 4 In the text box to the right of the label Count enter a value. Make sure the checkbox to the left of the word Count is checked.

Step 5 Click the **X** in the top right corner of the dialog box to close the dialog. A counter button should appear just below your selected event.

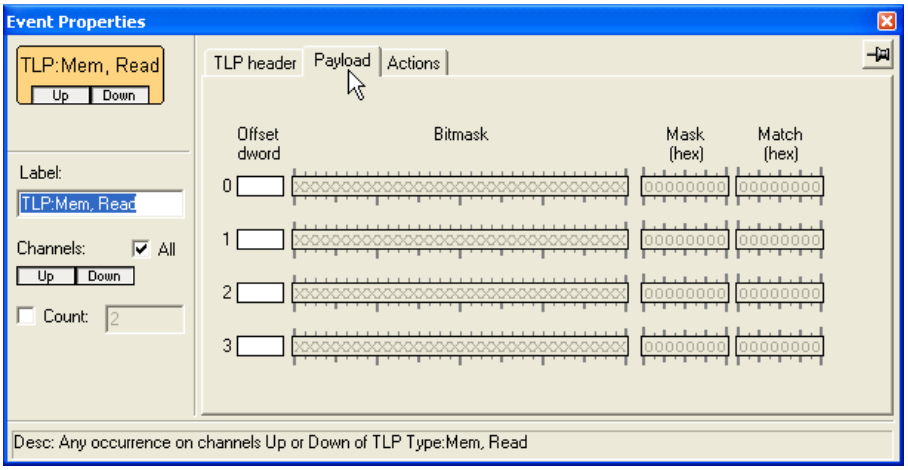


8.11 Creating a Payload Match

You can configure PE*Tracer* to trigger, count, and restart on a specific payload pattern within a Transaction Layer Packet (TLP). In Recording Rules, create a **New** event of the desired TLP type. An icon appears that represents that event type in the Available Events area. Right-click the icon and select **Properties** to bring up the Properties dialog box for the event.



Select the **Payload** tab to bring up the pane that lets you configure payload pattern. You can match up to four patterns, labeled 0 through 3.



For each pattern, you specify the following:

Offset dword: Indicates the DWORD you want to match within the payload (range is 0 through 1024). For example, if you want the Analyzer match a pattern in the first DWORD of the payload, enter 0. If you want the Analyzer to match a pattern in the thirty-fifth DWORD, enter 35.

Bitmask: Indicates which bits you want to match for the DWORD indicated. You can enter any of the following in the bitmask area:

- X (bit not relevant)
- 1 (present)
- 0 (bit not present)

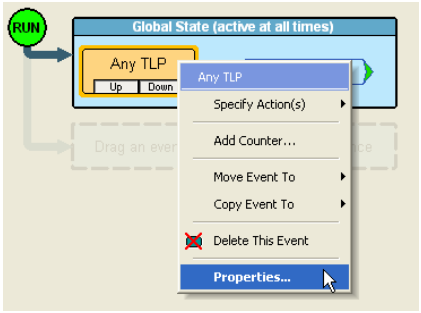
Note: The Mask (hex) and Match (hex) entries represent bitmask in hex format. As you type entries in the bitmask, corresponding values appear in fields in the hex Mask and Match. Alternately, you can type values in the hex Mask and Match, and corresponding values appear in the bitmask.

Example 1

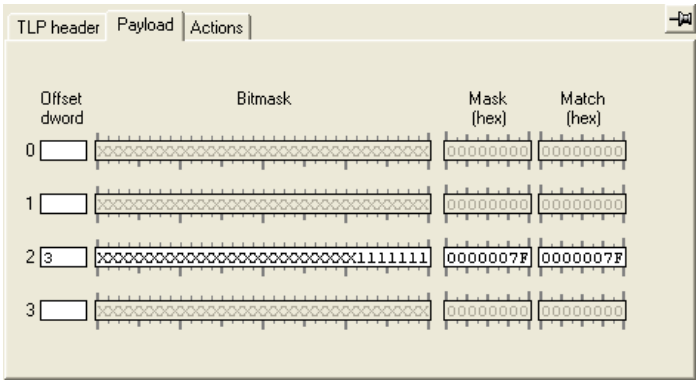
To tell the Analyzer to trigger on any payload with the binary pattern 1111111 in the third DWORD:

Step 1 Create an **Any TLP** event in the Available Events area of Recording Rules. Drag the event to the **Global State** cell.

Step 2 Open the **Properties** dialog box for the event and bring up the **Payload** pane.



Step 3 Enter **3** in the Offset dword area of any of the four patterns (0 to 3). For purposes of this example, we choose pattern 2.



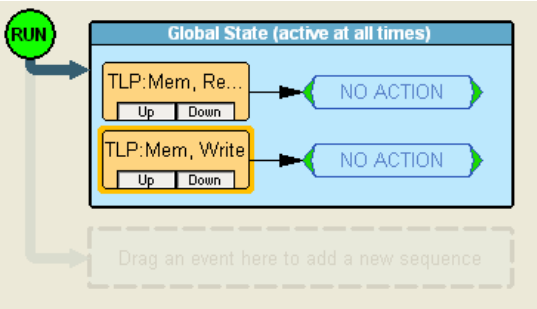
Step 4 Enter the following in pattern 2: **1111111**.

Example 2

To tell the Analyzer to trigger on any payload with the binary pattern 1111111 in the third DWORD, OR to trigger on any occurrence of Memory Write:

Step 1 To set up the first condition, do steps 1 through 4 in Example 1.

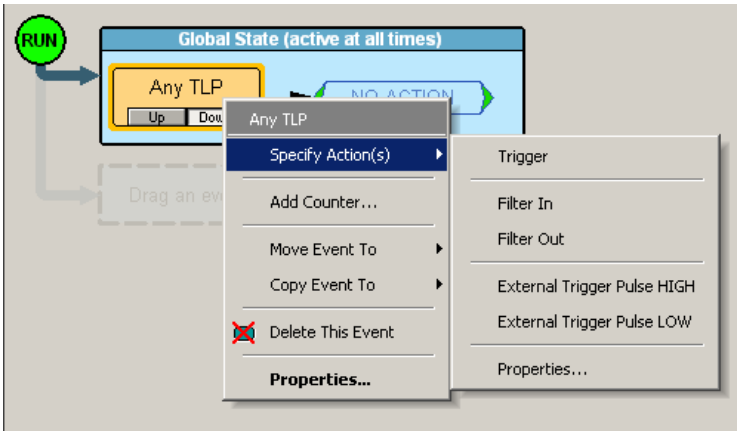
Step 2 Create a **Memory Write** event in the Available Events area of Recording Rules. Drag the **Memory Write** icon to the same cell as the **Any Event** icon from Example 1. The Analyzer now is set to trigger on either of the two conditions.



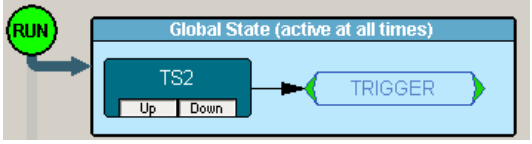
8.12 Trigger

A trigger is one of five actions that can be assigned to an event. (The other four actions are Filter In, Filter Out, Advance the Sequence, and Restart the Sequence.)

To enable a trigger, place an event button into either the **Global State** cell or the **Sequence** cell, then right-click the button and choose an **Action**.



From the sub-menu, select **Trigger**.



The exact end of the recording depends on how you have set the Trigger Position slider in the General page of the Recording Options dialog. This setting determines whether the recording terminates immediately following a trigger, or some time afterwards. See “General Tab” on page 118 for further explanation.

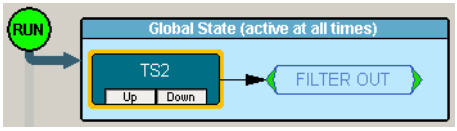
8.13 Filter In and Filter Out

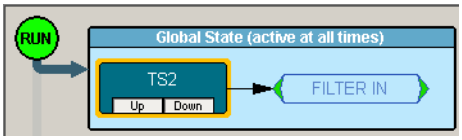
A filter causes the Analyzer to filter in or out specified events from the recording. If events are filtered out of the recording, they are excluded from the Analyzer's buffer and not simply hidden from the CATC Trace. The purpose of filtering is to preserve recording memory so you conduct longer recording sessions and exclude events that do not interest you.

A filter causes the Analyzer to filter in or out specified events from the recording so you can preserve recording memory and thereby increase the duration of your recording. Filtering also lets you exclude unwanted data so your CATC Trace displays only the traffic that interests you.

To enable or disable filtering, place an event button into either the **Global State** cell or the **Sequence** cell, then right-click the button and choose an **Action** (see previous topic).

From the sub-menu, select **Filter In** or **Filter Out**.





Chapter 9: Reports and Tools

Reports assist you in analyzing traffic recorded by the Analyzer. The available reports are:

- **File Information**: To view general information about the CATC Trace file.
- **Error Summary**: To view a count of errors in a CATC Trace file.
- **Traffic Summary**: To view a summary of protocol-related information in the CATC Trace file summary information about a selected group of items in the CATC Trace file (such as a count of particular frame or packet types).
- **Bus Utilization**: To display information on bandwidth usage for the transmit and receive channels.
- **Link Tracker**: Displays a detailed chronological view of events.
- **Data Flow**: Shows marker, packet, direction, type, length, address, payload, handshake, and timestamp information.
- **Trace Navigator**: Navigates within the CATC Trace to view the location of errors and triggers, narrow the range of traffic on display, and jump to any point in the CATC Trace.
- **LTSSM Flow Graph**: Shows a state diagram of bus activity.
- **Packet Header**: Shows packet header information
- **Packet Data**: Shows packet information.
- **Configuration Space**: To display a Configuration Space (see “Configuration Space” on page 241).
- **Metrics**: Measures key operating parameters.
- **Real Time Statistics**: To display statistical information for the channels.
- **TC to VC Mapping**: To display how Traffic Classes are mapped to Virtual Channels (to simplify navigation) and how the CATC Trace display was changed (for example, in Split Transactions).
- **Timing Calculations**: To view timing measured between two events set within the CATC Trace file.
- **Run Verification Scripts**: Allows you to check errors, link transactions, split transactio“Configuration Space” on page 241ns, metrics, ordered sets,replays, DLLPs, and TLPs.

Reports are available from the Report menu and buttons on the Tool bar. Tools are available from the Tools menu.

9.1 File Information

The File Information window provides a summary on the currently displayed file.

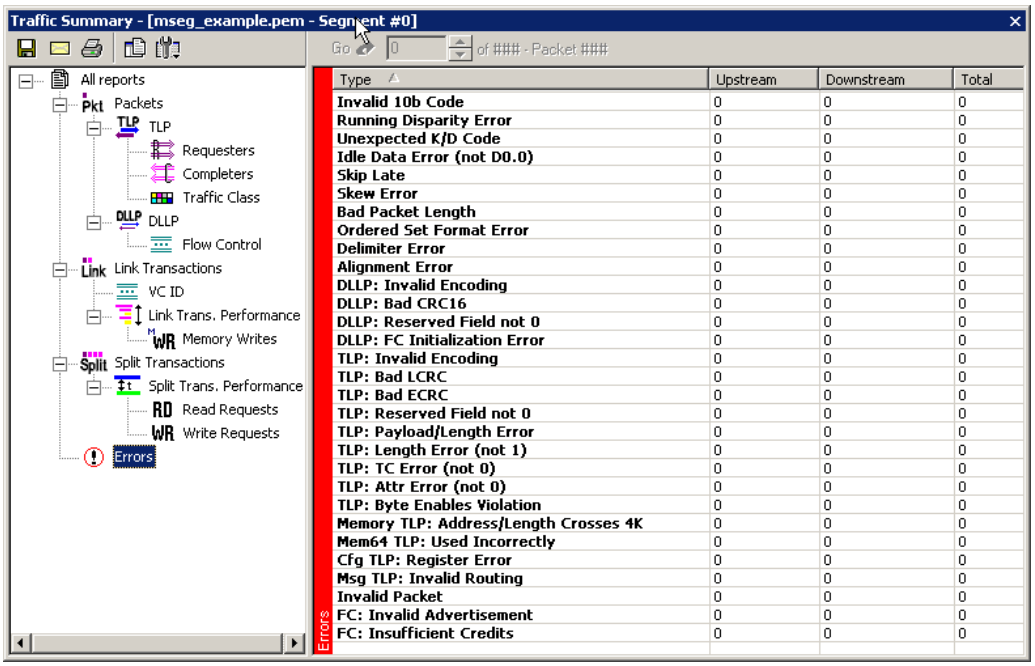
Select **Reports > File Information** to obtain the File Information window.

File Information
File name : Training_x8.pex
Converted to PETracer format from file Training_x8.pex.bak,
Trace occurred : Monday, August 11, 2003 13:40:49
Number of packets: 2281
Trigger packet number: 4
Recorded with 'CATC PETracer' analyzer, version 2.00 (Build 24)
Analyzer Serial Number: 00232
Motherboard: 0x1 Version: 0x3
Firmware version: 1.00 (ROM 70.93)
BusEngine version: 1.00
BusEngine type: 0
UPAS Slot 1 - Part Number: PE801MA, PlugIn ID: 0x24, Version: 0x2
UPAS Slot 2 - Part Number: PE801MA, PlugIn ID: 0x24, Version: 0x2
Number of markers : 1
Base Spec Rev1.0 used during the recording.
License information for the product, Serial Number 00232, used to record this trace file :
Software maintenance expired on 10/01/2004.
Available Features
Feature Title
Purchased
Feature Description
x8 link Recording
Yes
Ability to record x8 traffic
x4 link Recording
Yes
Ability to record x4 traffic
x2 link Recording
Yes
Ability to record x2 traffic
Real-Time Bus Monitoring
Yes
Real-time monitoring (plots and counters) of the PCI Express link
Recording buffer 512 MB
Yes
Recording buffer size limited to 512 Megabytes or less
Recording buffer 1 GB
Yes
Recording buffer size limited to 1 Gigabyte or less
Recording buffer 2 GB
Yes
Recording buffer size 2 Gigabytes (maximum) or less
Recording Rules Sequencer
Yes
Ability to create complex sequences of events and actions for triggering and filtering in Recording Options
Traffic Summary View
Yes
Navigable tables with reports presenting statistics of various events in the trace
Link Tracker View
Yes
A view presenting time based display of both directions of the PCI Express link
Graphical Bus Utilization View
Yes
A view presenting plots of various performance and utilization measurements for the trace over time
Metric-based performance
Yes
Metric-based performance measurements - calculating of various performance metrics for Link and Split transactions, display of the metrics in Trace View, Traffic Summary reports and Bus Utilization graphs based on metrics, timing calculations based on
Save As...
Close

9.2 Error Summary

The Error Summary dialog box displays the number of errors for each event and the packet containing the errors.

Select **Reports > Error Summary** to obtain the Error Summary dialog box.

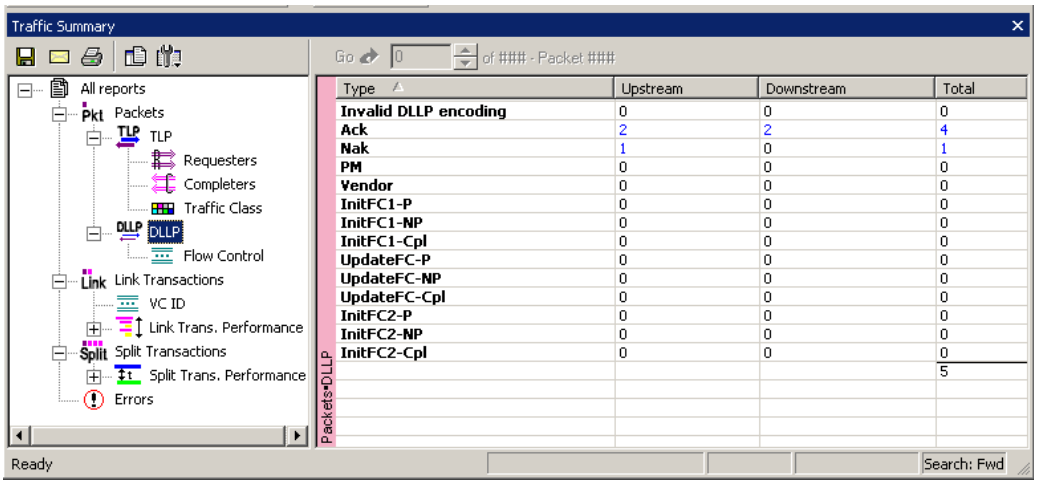


Type	Upstream	Downstream	Total
Invalid 10b Code	0	0	0
Running Disparity Error	0	0	0
Unexpected K/D Code	0	0	0
Idle Data Error (not D0.0)	0	0	0
Skip Late	0	0	0
Skew Error	0	0	0
Bad Packet Length	0	0	0
Ordered Set Format Error	0	0	0
Delimiter Error	0	0	0
Alignment Error	0	0	0
DLLP: Invalid Encoding	0	0	0
DLLP: Bad CRC16	0	0	0
DLLP: Reserved Field not 0	0	0	0
DLLP: FC Initialization Error	0	0	0
TLP: Invalid Encoding	0	0	0
TLP: Bad LCRC	0	0	0
TLP: Bad ECRC	0	0	0
TLP: Reserved Field not 0	0	0	0
TLP: Payload/Length Error	0	0	0
TLP: Length Error (not 1)	0	0	0
TLP: TC Error (not 0)	0	0	0
TLP: Attr Error (not 0)	0	0	0
TLP: Byte Enables Violation	0	0	0
Memory TLP: Address/Length Crosses 4K	0	0	0
Mem64 TLP: Used Incorrectly	0	0	0
Cfg TLP: Register Error	0	0	0
Msg TLP: Invalid Routing	0	0	0
Invalid Packet	0	0	0
FC: Invalid Advertisement	0	0	0
FC: Insufficient Credits	0	0	0

9.3 Traffic Summary

The Traffic Summary window summarizes the traffic in the current CATC Trace. The left side of the window displays a tree of protocol levels. The right side displays a summary of traffic for the displayed levels.

Select **Reports > Traffic Summary** or click to display the Traffic Summary window.



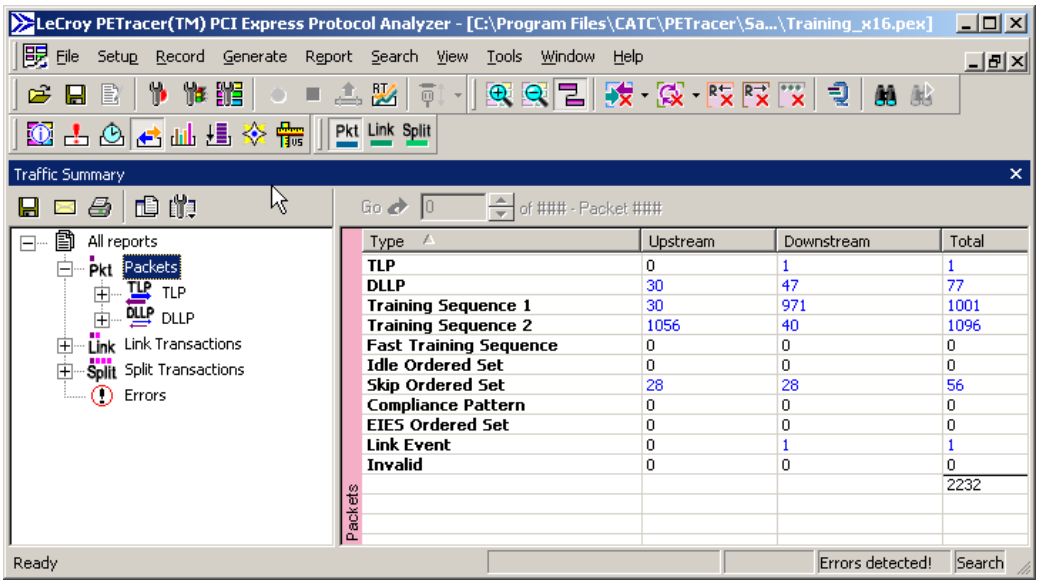
Buttons at the top of the Traffic Summary window change the display format and enable data to be exported to email, file, or the printer.

Using the Traffic Summary Window to Search the CATC Trace

You can use the Traffic Summary window to move the CATC Trace to packets of interest:

Step 1 Click one of the numbers in the right side of the Traffic Summary window.

The CATC Trace jumps to the first instance of the selected protocol.



Step 2 Click the **up** or **down** arrows

. The CATC Trace jumps forward or backward through the display to the next instance of selected protocol level.

Traffic Summary Buttons

Buttons at the top of the Traffic Summary dialog box provide options for exporting the data or formatting its appearance:

Save. Saves Traffic Summary results into an HTML format.

Email. Attaches an HTML file of the results to a new email.

Print. Prints results.

Text. Displays results in HTML format.

Options. Opens a drop-down menu with the following options:

- **Grid Lines**: Displays/Hides grid lines
- **Row Selection**: Allows entire rows to be selected
- **Tight Columns**: Reformats column widths to match data
- **Event Navigation**:

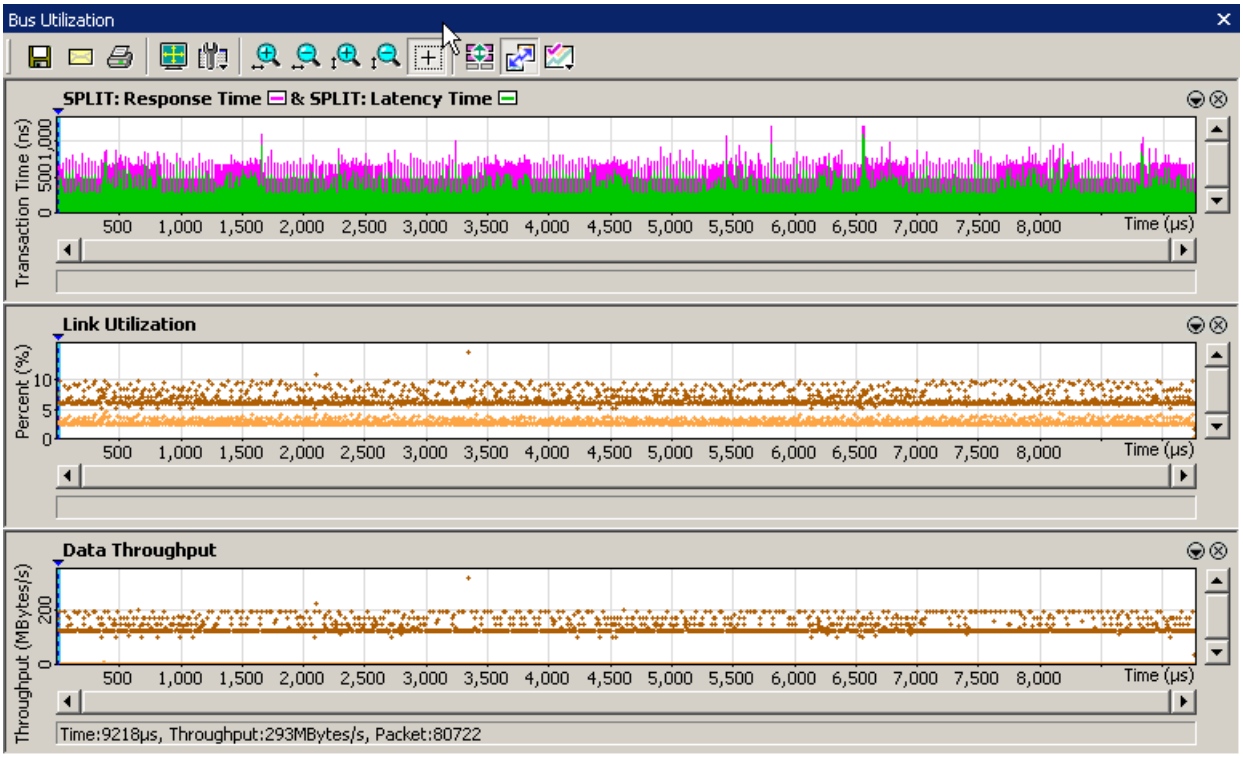
  Skip Hidden Items

  Show Hidden Items

  Prompt each time

9.4 Bus Utilization

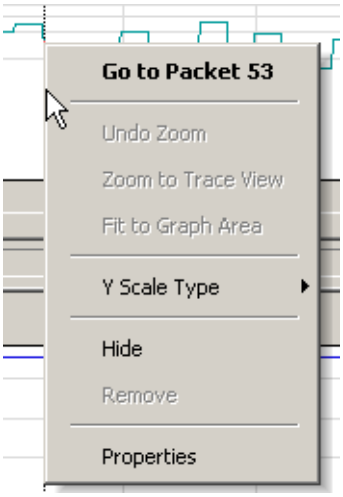
Select **Report > Bus Utilization** from the menu or press to open the Bus Utilization window.



The Bus Utilization window displays information on bandwidth use for the transmit and receive channels.

Bus Utilization Pop-up Menu

You can reformat the display by right-clicking a graph and making a selection from the Bus Utilization pop-up menu.



Go to Packet #: Relocates the CATC Trace to the selected packet number.

Undo Zoom: If you have zoomed in, this command undoes the zoom.

Zoom to Trace View: Zooms in on graph to show traffic currently displayed in the CATC Trace screen.

Fit to Graph Area: Redisplays graph so that the entire CATC Trace fits inside graph area.

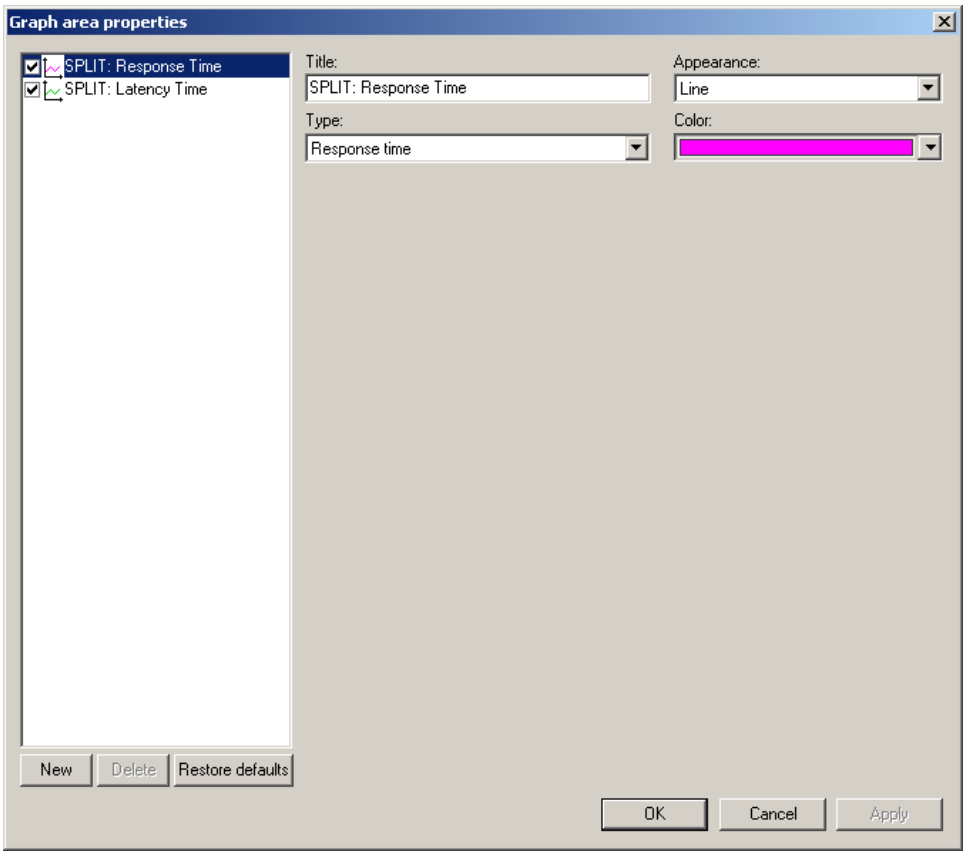
Y Scale Type:

- **Linear**: Converts display to linear format
- **Logarithmic**: Converts display to logarithmic format

Hide: Hides the selected graph

Remove: Allows you to remove any graph that you created via the **New** command

Properties: Opens a dialog box with options for changing the Title, Type, Appearance, and Color of the graphs.



Bus Utilization Buttons

The Bus Utilization window buttons allow you to reformat the display and export data.

Button	Function
	Save. Saves Bus Utilization data to a bitmap file (***.bmp**).
	Email. Opens an email and attaches a bitmap file of the Bus Utilization data.
	Print. Prints the Bus Utilization data.
	Full Screen. Maximizes the Bus Utilization window.
	View Settings. Opens a sub-menu with the following choices: • Orient Horizontally • Tile Vertically • Show Markers • Show Plumbline • Status >> Bar Tool tips None • Grid Lines >> Both Axes X Axis Y Axis No Grid • Grid on Top • Fonts & Colors
	Horizontal zoom in
	Horizontal zoom out

Vertical zoom in

Vertical zoom out

Click and Drag zoom. Click and drag to zoom in on a part of the graph.

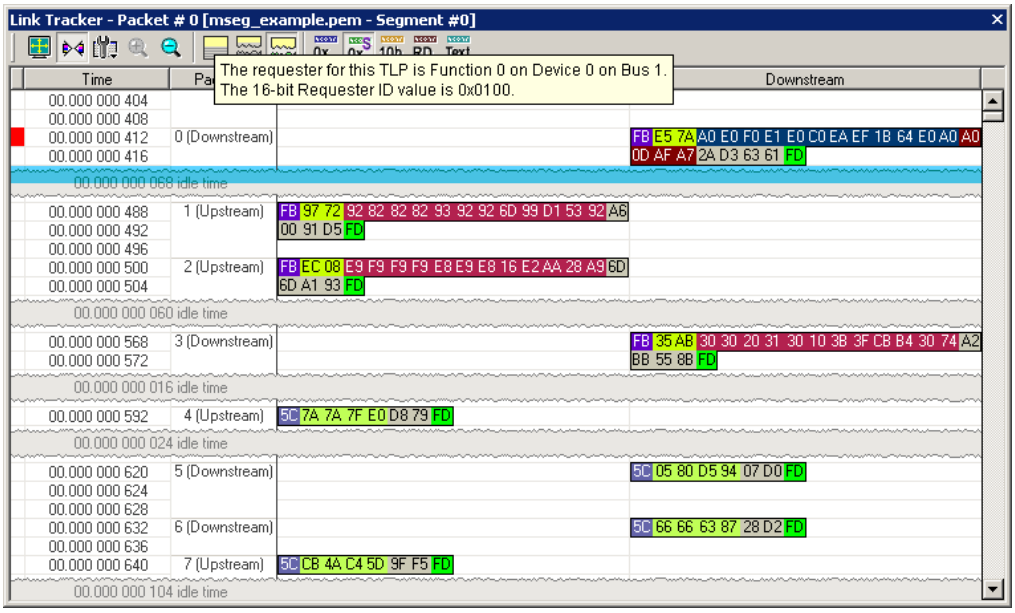
Select Range. Displays a dialog box for selecting a packet range.

Synchronize Graph Areas. If two or more graphs are displayed, this button synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.

Graph Areas. Provides options for creating and displaying additional graphs of data lengths, packet lengths, and percentage of bus used.

9.5 Link Tracker

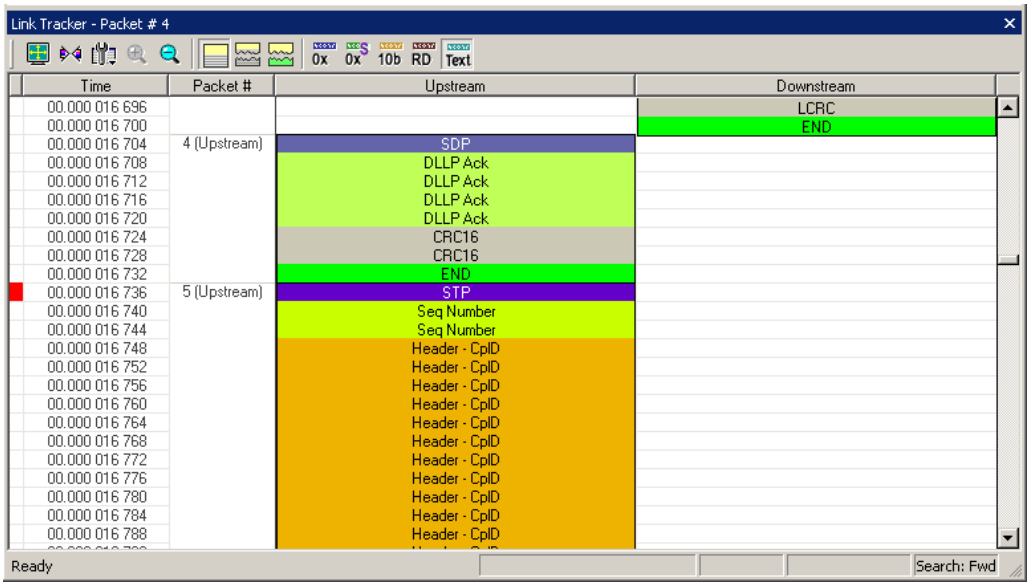
The Link Tracker window displays a detailed chronological view of events. Events are shown on a channel-by-channel basis in columns within the window.



Each time slot in the vertical axis represents the minimum time that a DWORD requires to traverse the bus.

Toolbar: Presents buttons for changing the format of the Link Tracker window.

Main Display Area: Displays traffic chronologically as it occurred in the recording. The window divides into columns: the first column shows time and traffic is shown on a channel-by-channel basis in the columns on the right.



Using the Link Tracker Window

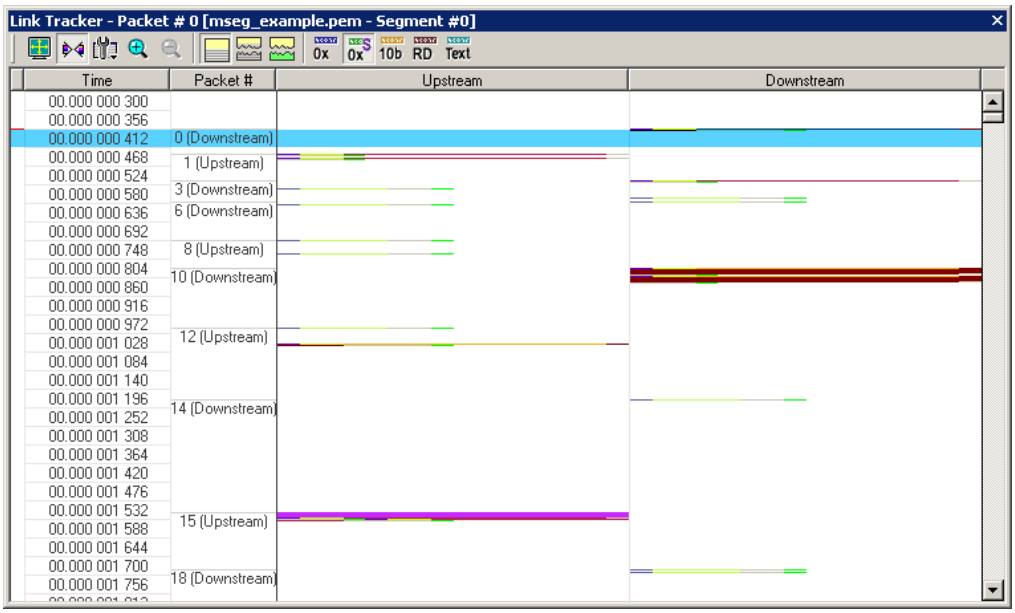
The Link Tracker window can be reformatted in several ways.

Zooming In and Out

Zooming out can give you a quick, high-level view of a CATC Trace. A fully zoomed out CATC Trace only shows columns and colored lines. Using the colors, you can see what types of traffic run through the CATC Trace.

Further information can be obtained on any point of interest in the CATC Trace by positioning your mouse pointer over it. Tool tips provide detailed description of events.

Note: When fully zoomed out, the smallest graphical unit is the DWORD, represented by a single line. Zooming out makes the CATC Trace appear smaller and increases the time scale in the first column.



Collapsing Idle Time, Enabling Tool tips, and Resetting Column Widths

Click the **View Options** button to open a menu with options for formatting the display. Three options are presented:

Collapsible Idle Time: Opens a dialog box for setting the Idle time value. Setting a value tells the Analyzer when to collapse Idle times and display them as grayed out strips within the Bus View window.

Tooltip Display: Opens a menu with options for adding content to Tooltips. Tooltips display when you position the mouse pointer over an item in the Bus View window. The options are:

- Tooltips Display Values
- Tooltips Display Scrambled Values
- Tooltips Display 10-bit Codes
- Tooltips Display Symbols

Time Format: Seconds or Clock

Reset Column Widths: This option resets column widths to their defaults and enables columns to resize themselves automatically any time the application window is resized. Normally, columns automatically resize themselves if the application window is made larger or smaller. However, if you manually resize any columns in the Bus View window, column widths become static. Thereafter, if you resize the application window, the Bus View columns do not adjust automatically. Reset Column Widths re-enables the automatic resizing capability.

Reset Columns Order: Return to default column sequence.

Docking and Undocking the Window

You can undock the Link Tracker window by double-clicking the blue title bar along the left side of the window. Once undocked, the window can be dragged anywhere in the application. To redock, double-click again on the title bar.

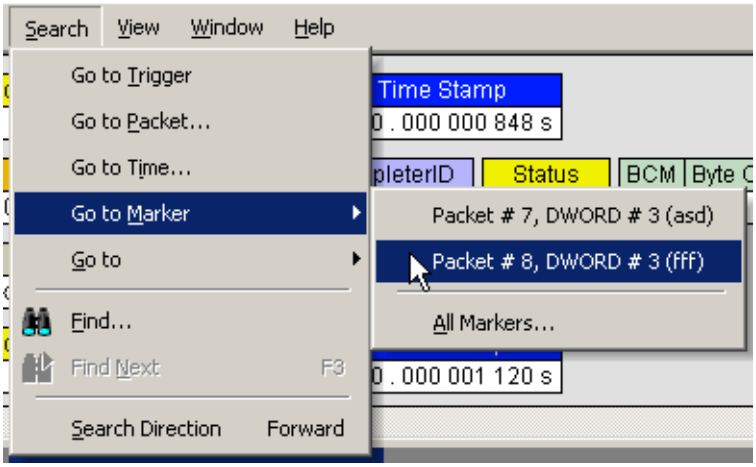
Setting Markers

Markers can be set on any event within the Link Tracker window.

To set a marker, right-click an event, then select **Set Marker** from the pop-up menu.

Once marked, you can navigate to events with the **Go to Marker** command in the Search menu.

Markers set in the Link Tracker window display the packet number and DWORD number. In contrast, markers set in the CATC Trace window just show the packet number.



Calculating Time between DWORDs

You can calculate time between DWORDs by clicking an event and then positioning your mouse pointer over a second event and reading the ensuing Tool tip.

Click the **time value** for the first event. Scroll down through the CATC Trace to the second event and position the mouse pointer above its time value. A Tool tip appears showing the time interval between the first and second events.

Hiding Traffic

You can hide Idles and other data from the Link Tracker window by clicking the **Hide** buttons on the toolbar.

Link Tracker Buttons

The Link Tracker window has a row of buttons for changing the format of the displayed data and for exporting data: The buttons have the following functions:

Full Screen. Expands the Link Tracker window to fill the entire screen.

View Options. Opens a menu with three options:

- **Collapsible Idle Time** (Collapse Idle Bigger Than **n** nanoseconds. **Note:** Does not affect Collapse Idle Plus.)
- **Tooltip Display** (Values, Scrambled Values, 10-bit Codes, Symbols)
- **Time Format** (Seconds, Clock)
- **Reset Columns Widths** (return to default widths)
- **Reset Columns Order** (return to default column sequence)

See “Using the Link Tracker Window” on page 164 for further details.

Synchronize Trace View. Synchronizes the Trace View and Link Tracker windows so that a move in one window repositions the other.
Because of the differences in scale and logic between the Link Tracker and Trace view window, scrolling produces different effects depending on which window is being scrolled.
Scrolling in the CATC Trace window causes the Link Tracker window to rapidly jump from event to event. Long periods of idle time are thus skipped.
Scrolling in the Link Tracker window, in contrast, produces modest movements within the CATC Trace window.
Scrolling in the Link Tracker window causes the CATC Trace window to pause until the beginning of a packet is displayed. At that point, the CATC Trace window repositions itself. While scrolling long Idle periods or through the contents of a packet, the CATC Trace window does not move.

Zoom In

Zoom Out

Continuous Time Scale. No collapsing.

Collapse Idle. Do not show some periods of Link being idle.

Collapse Idle Plus. Do not show periods of Link being idle.

Show Values

Show Scrambled Values

Show 10b Codes

Show Symbols

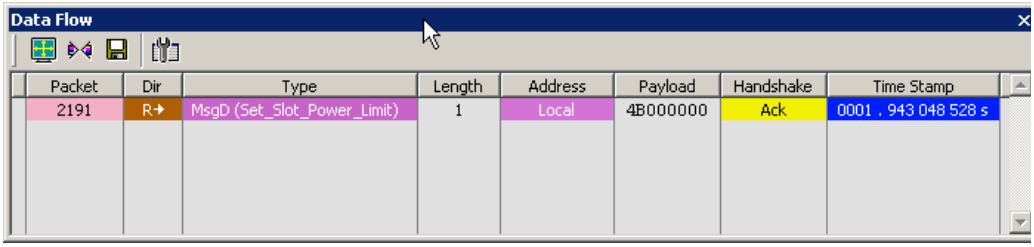
Show Text

9.6 Data Flow Window

The Data Flow window shows marker, packet, direction, type, length, address, payload, handshake, and timestamp information.

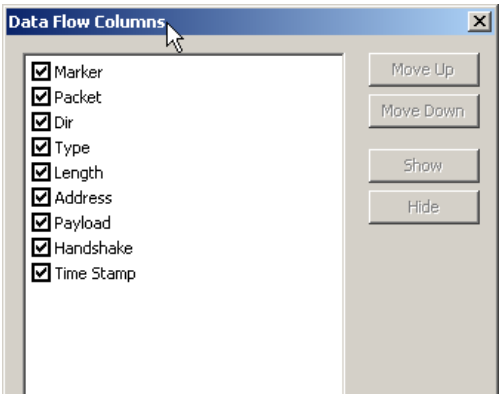
To obtain the Data Flow window, select **Report > Data Flow**

or click the Data Flow toolbar icon.



The toolbar allows you to:

- Expand the window to full screen or Collapse to a smaller window.
- Synchronize.
- Save.
- Select Data Flow columns to display and their widths:
  - Marker
  - Packet
  - Direction
  - Type
  - Length
  - Address
  - Payload
  - Handshake
  - Time Stamp

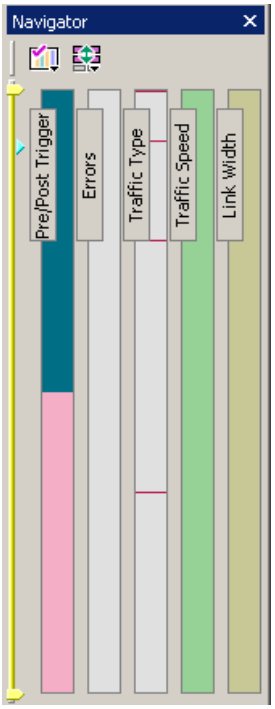


9.7 Using the Trace Navigator

The trace Navigator is a tool for navigating within the CATC Trace. It allows you to view the location of errors and triggers in a CATC Trace and to narrow the range of traffic on display. It also allows you to quickly jump to any point in the CATC Trace.

Displaying the Navigator

Click in the toolbar to display the Navigator. The Navigator appears on the right side of the Main window. It has a two-button toolbar and a vertical slider bar. It also has colored panes for navigating the CATC Trace in different ways. You set which panes are displayed through Navigator pop-up menus.



Navigator Toolbar

The Navigator toolbar lets you quickly set Navigator features. The toolbar has two buttons.

Navigator Ranges: This button brings up a pop-up menu that lets you reset the Navigator range. The range determines what packets are viewable in the CATC Trace display.

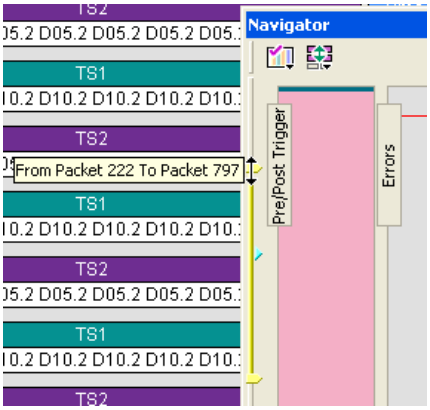
Navigator Panes: This button has two purposes: To select which Navigator panes appear and to bring up the Navigator legend. The legend determines how information is shown in the panes.

Navigator Ranges

You set the viewing range by dragging the **yellow range delimiters** along the slider.

To set the lowest packet viewable, drag the **top delimiter up**. As you do so, a tool tip appears to indicate the current range. Stop dragging when you reach the desired lowest packet.

To set the highest packet viewable, drag the **bottom delimiter down**. Stop when the tool tip indicates you are at the desired highest packet.



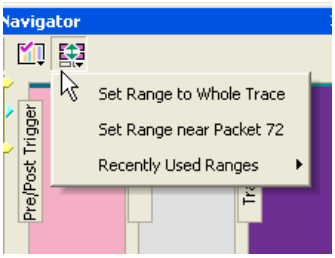
To Determine Current Position

In addition to the two range delimiters, the slider has a **blue current-position** indicator (see above). The current-position indicator shows where you are in the CATC Trace display with respect to the possible viewing range.

For example, suppose you set viewing range to packet 0 through packet 500 (the top range delimiter is at packet 0, and the bottom range delimiter is at packet 500). If you then move the current-position indicator on the slider to midway between the top and bottom delimiters, then packet 250 appears in the middle of the CATC Trace display.

To Reset Navigator Range

You can reset the Navigator range using the toolbar **Navigator Range** button. Press the button to bring up the Navigator Range drop-down menu.

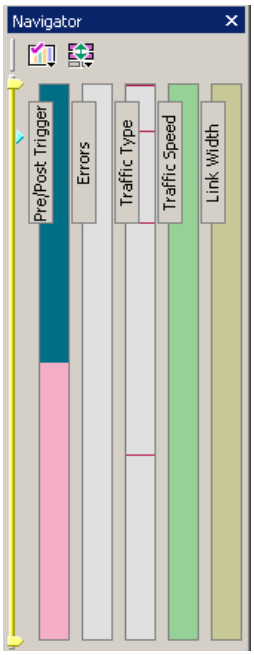


The menu has the following options:

- **Set Range to Whole Trace**: Allows you to reset the range to include the entire CATC Trace file contents. The top range delimiter is placed at the lowest packet number in the CATC Trace. The bottom range delimiter is placed at the highest packet number in the CATC Trace.
- **Set Range Near Packet xxx**: Allows you to collapse the range so that only the packets immediately above and below the xxx packet are displayed. The xxx packet is whatever packet is currently at the top in the CATC Trace display.
- **Recently Used Ranges**: Allows you to reset the range to any of a number of recently used (previously set) ranges.

Navigator Panes

You can display any combination of CATC Trace Navigator panes.



From left to right, the panes are: Pre/Post Trigger, Errors, Traffic Type, Traffic Speed, and Link Width. Each pane represents the entire CATC Trace with respect to different types of information. The top of each pane represents the start of the CATC Trace file, and the bottom represents the end of the CATC Trace file.

- **Pre/Post Trigger:** To view the trigger event in the CATC Trace and the relative size of pre-trigger and post-trigger portions of the CATC Trace. The two portions are set apart as different colors. The trigger event occurs at the point the two colors meet.
- **Errors:** To view any errors in the CATC Trace. A thin red line represents each error in the pane.
- **Traffic Type:** To view the types of packets that occur in the CATC Trace. A different color represents each packet type in the pane. The relative size of colored portions in the pane corresponds to the amounts of the various packet types in the CATC Trace. As described below, you can use the Navigator legend to change the types of packets that take precedence in the display.
- **Traffic Speed:** To view the speed that occurs in the CATC Trace.
- **Link Width:** To view the link width that occurs in the CATC Trace.

To Show/Hide Navigator Panes

You can show/hide any of the panes using pop-up menus accessible through left-click the **Navigator Panes** button or by right-click anywhere in any CATC Trace Navigator pane.

Navigator Slider

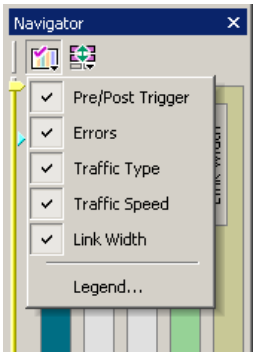
The Navigator slider appears at the left of Navigator panes. The slider has **yellow upper and lower range delimiters** and a **blue current-position** indicator.

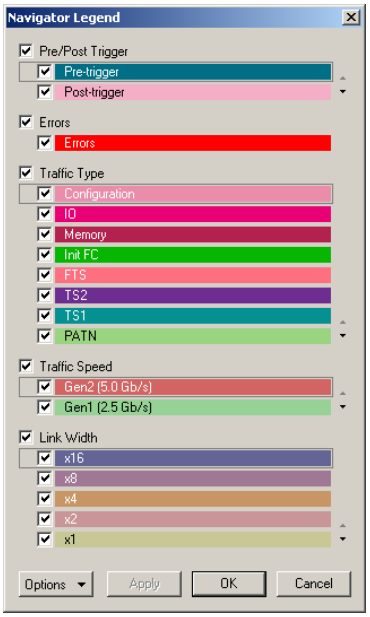
The Navigator slider lets you to set the range of packets viewable in the CATC Trace display. In other words, it sets scrolling range of the display. You can scroll the display up to the lowest packet number in the viewing range. You can scroll the display down to the highest packet number in the viewing range.

Trace Navigator Legend

The Navigator legend lets you control the display of content in Navigator panes.

You bring up the legend through the Navigator Panes drop-down menu. Press the toolbar **Navigator Panes** button to access the menu. Select the **Legend** option to bring up the Navigator Legend dialog box.





The Navigator Legend dialog box has areas corresponding to each of the panes. Each area has check boxes that allow you to hide/display information in the pane. You can set the priority of information displayed in the panes using the up and down triangles on the right.

Using the Legend to Show/Hide Navigator Panes

To use the legend to show/hide an entire pane, use the **checkbox** next to the name of each pane in the legend.

In the case of the Pre/Post Trigger and Errors areas, the action of show/hide in the legend is identical to that provided by Trace Navigator pop-up menus.

In the case of the Traffic Types pane, there is no equivalent show/hide available through the pop-up menus.

Using the Legend to Set the Priority of Information Display

You can use the legend to set the priority of information displayed in the Pre/Post Trigger Traffic Type panes. This is a two-step process.

Step 1 For a particular item in a pane, click the **column next to the checkbox** for the item. That labels the item as currently active.

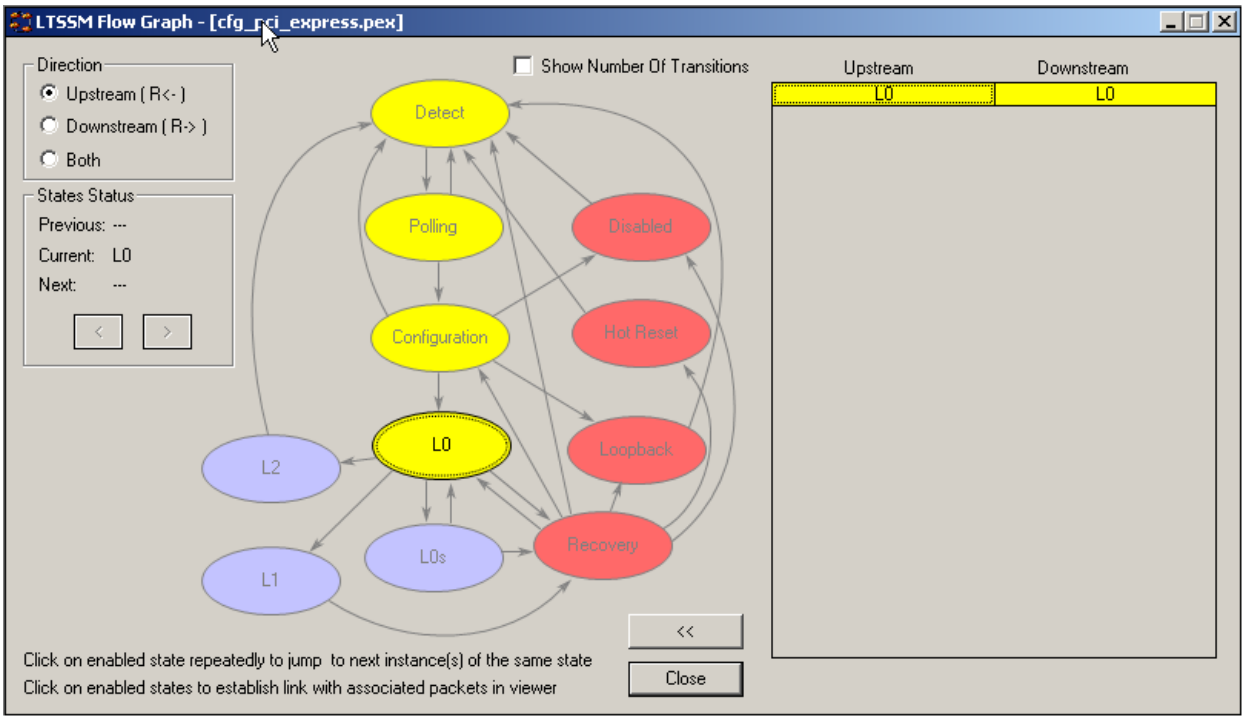
Step 2 Next, use the **up-down** at the lower-right of the area to move the item higher or lower in priority.

In the case of the Traffic Type pane, priority determines display priority of each packet type. For portions of the CATC Trace that are dominated by a particular packet type, this setting no effect: only the color corresponding to that packet type is displayed in that portion of the pane. Suppose, however, that part of the CATC Trace includes equal or near equal numbers of several types of packets. In that case, you can use the legend to select which among those types is represented in that portion of the Traffic Types pane. This allows you to view only packets of interest in crowded portions of the CATC Trace display.

9.8 LTSSM Flow Graph

The LTSSM Flow Graph shows link state transitions that the link goes through, as recorded in the CATC Trace file.

To obtain the LTSSM Flow Graph, select **View > LTSSM Flow Graph**.



You can display the following directions:

- **Upstream**
- **Downstream**
- **Both**

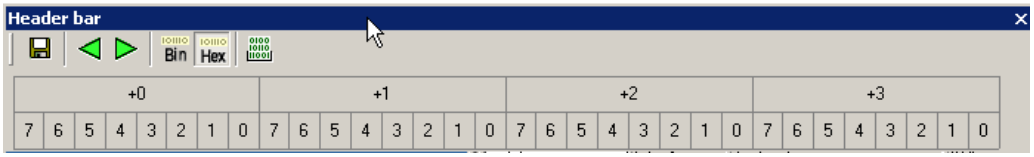
You can **Show Number of Transitions**.

9.9 Packet Header Bar

The Packet Header bar shows packet header information.

To obtain the Packet Header bar, select **Report > Packet Header**

or click the Packet Header toolbar icon.



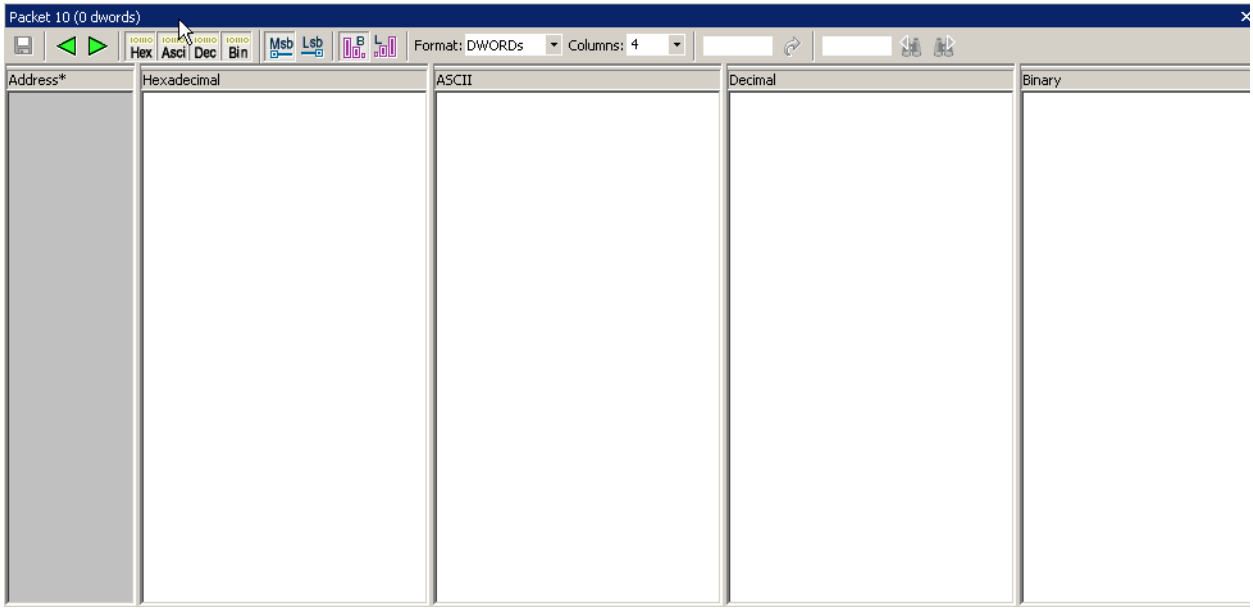
The toolbar allows you to Save, go to Previous or Next, display Hexadecimal or Binary, and show the Packet Data window.

9.10 Packet Data Window

The Packet Data window shows packet information.

To obtain the Packet Data window, select **Report > Packet Data**

or click the toolbar icon.



The toolbar allows you to Save; go to Previous or Next; display Hexadecimal, ASCII, Decimal, or Binary; use MSB Format or LSB Format; and use Big Endian or Little Endian.

Format and Columns allows you to enter the number of bytes, words, or dwords per line.

You can enter an Offset and scroll to it.

You can enter text and Search Previous or Search Next.

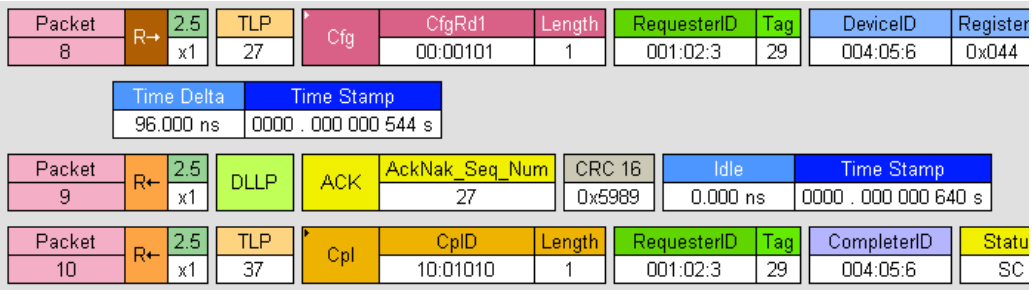
9.11 Configuration Space View

The Configuration Space View displays information about the Configuration Space state as of the current packet of the currently selected device. The view shows the Configuration Space Header and the PCI-compatible or PCI Express Capability Structures.

To display the Configuration Space View for a device at a packet:

Step 1 Open a CATC Trace, such as the sample file **cfg_pci_express.pex**.

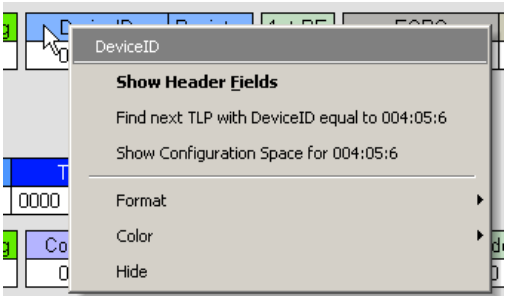
Step 2 Scroll to a packet with a Configuration header.



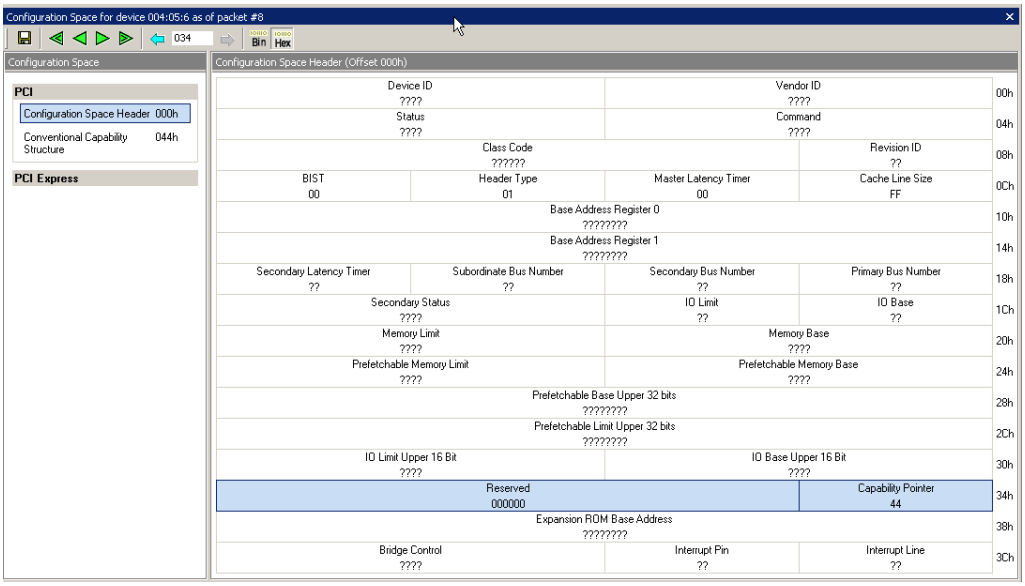
Step 3 Select **Report > Configuration Space > <device>** to display the Configuration Space View.

or

Click a **CompeterID** or **DeviceID** field. A pop-up menu opens.



Select **Show Configuration Space for xxxx** from the menu, where **xxxx** is the device number. The Configuration Space View opens.


Configuration Space for device 004:05:6 as of packet #8
034
Bin
Hex
Configuration Space
PCI
Configuration Space Header 000h
Conventional Capability Structure 044h
PCI Express
Configuration Space Header (Offset 000h)
Device ID ???? Vendor ID ???? 00h
Status ???? Command ???? 04h
Class Code ?????? Revision ID ?? 08h
BIST 00 Header Type 01 Master Latency Timer 00 Cache Line Size FF 0Ch
Base Address Register 0 ???????? 10h
Base Address Register 1 ???????? 14h
Secondary Latency Timer ?? Subordinate Bus Number ?? Secondary Bus Number ?? Primary Bus Number ?? 18h
Secondary Status ???? IO Limit ?? IO Base ?? 1Ch
Memory Limit ???? Memory Base ???? 20h
Prefetchable Memory Limit ???? Prefetchable Memory Base ???? 24h
Prefetchable Base Upper 32 bits ???????? 28h
Prefetchable Limit Upper 32 bits ???????? 2Ch
IO Limit Upper 16 Bit ???? IO Base Upper 16 Bit ???? 30h
Reserved 000000 Capability Pointer 44 34h
Expansion ROM Base Address ???????? 38h
Bridge Control ???? Interrupt Pin ?? Interrupt Line ?? 3Ch

On the left, the view displays the Configuration Space for the selected CompleterID or DeviceID at the current packet. You can select **Configuration Space Header** or a **Capability Structure.**

The right displays the decoded data of the selected Configuration Space Header or a Capability Structure, up to the current packet. (The decoding builds while navigating through the next packets.)

The Configuration Space View toolbar allows you to Save, go to First, go to Previous, go to Next, go to Last, go to Previous Access to Selected Configuration Space Register, go to Next Access to Selected Configuration Space Register, and display Hexadecimal or Binary.

Note: See Appendix A “Configuration Space Decoding” on page 249.

9.12 Using Unit Metrics

For every protocol unit at the Link or Split transaction level, PE*Tracer*™ calculates and displays a set of metrics. Metrics are measurements of key operating parameters. You can use metrics to evaluate performance of traffic in the CATC Trace stream.

You can view metrics information in the CATC Trace display, the Traffic Summary window, and the Bus Utilization window.

PE*Tracer* defines different metrics for Link and Split transactions.

Metrics Defined for Link Transactions

Number of Packets: The total number of packets that compose this Link transaction.

Payload: The number of data payload bytes this Link transaction transferred.

Response Time: The time it took to transmit this Link transaction on the PE link, from the beginning of the first packet in the transaction to the end of the last packet in the transaction.

Data Throughput: The payload divided by response time, expressed in megabytes per second.

Note: Usually, the Number of Packets metric for a link transaction is two (in case of explicit acknowledge) or one (in case of implicit acknowledge). However if Naks/link level retries are involved, this metric might be higher. As a result, the Number of Packets metric is useful in highlighting unusual link transactions.

Metrics Defined for Split Transactions

The following types of metrics currently are defined for Split transactions:

Number of Link Transactions: The total number of Link transactions that compose this Split transaction.

Payload: The number of payload bytes this Split transaction transferred.

Response Time: The time it took to transmit this Split transaction on the PE link, from the beginning of the first packet in the Split transaction to the end of the last packet in the Split transaction;

Data Throughput: The transaction payload divided by response time, expressed in megabytes per second.

Latency Time: The time measured from the end of the request transaction to the first completion transmitted in response to the request within this Split transaction.

Note: The Number Of Link Transactions metric for a Split Transaction usually is two for a Configuration or IO request. It can be bigger then two for a Memory Read request.

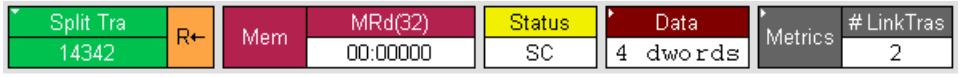
Show Metrics in the CATC Trace Display

In the CATC Trace view display of Link Transaction or Split Transaction levels, all metrics information applicable to a specific protocol unit is displayed in a Metrics header. The header is located close to the end of the unit, in front of the Time cell. You can expand and collapse the header to show or hide the metrics information.

Collapsed Metrics Header Display

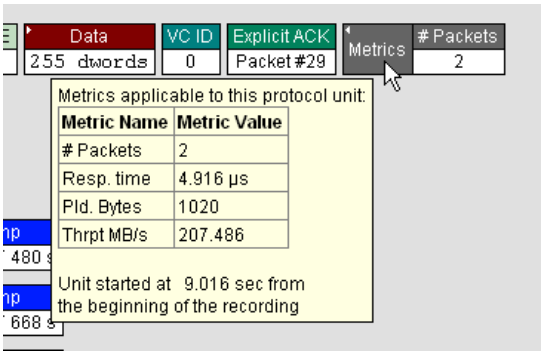
Following is a collapsed metrics display for a unit of Link Transaction. The collapsed header display shows only the metrics cell representing the Number of Packets.

Following is a collapsed metrics display for a unit of Split Transaction. The collapsed header display shows only the metrics cell representing Number of Link Transactions.



Metrics Tool Tip Display

In both CATC Trace level views, you can view the summary of all the unit metrics in the Metrics header tool tip. To view the tool tip, simply place the mouse cursor over the Metrics header. Following is the tool tip for a unit in the Link Transaction view.



Note: The tool tip also presents information for time passed from the start of the recording till the beginning of this Link or Split Transaction.

Expanded Metrics Header Display

When you expand the Metrics header, the display creates a separate cell for each applicable metric:

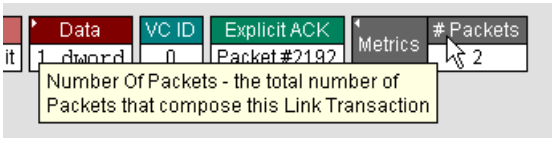
Following is the expanded Metric header for a unit in the Split Transaction view.

Metrics	# LinkTras	Resp. time	Latency	Thrpt MB/s	Pld. Bytes
	2	7.460 µs	6.736 µs	2.145	16

Following is the expanded Metric header for a unit in the Link Transaction view.

Metrics	# Packets	Resp. time	Pld. Bytes	Thrpt MB/s
	2	536.000 ns	64	119.403

Note: Each of the metric cells pops up a tool tip window with the explanation of what the metric means.

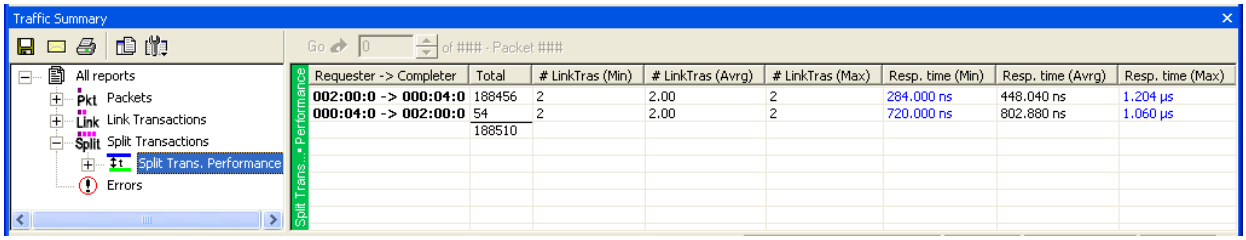


Show Metrics in the Traffic Summary Window

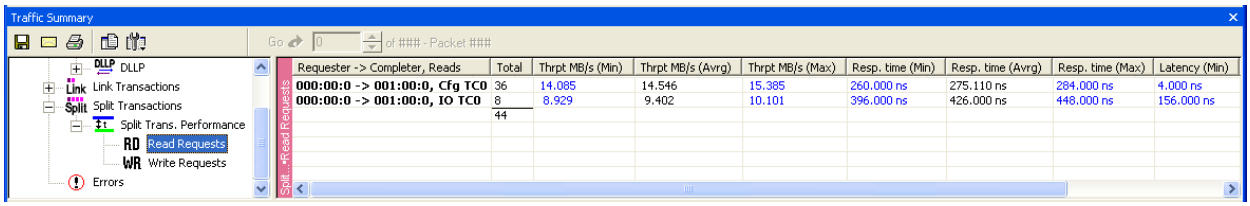
Some of the Traffic Summary reports at the Link and Split Transaction levels are based on metrics collected for the corresponding protocol units in the CATC Trace.

Reports at Split Transaction Level

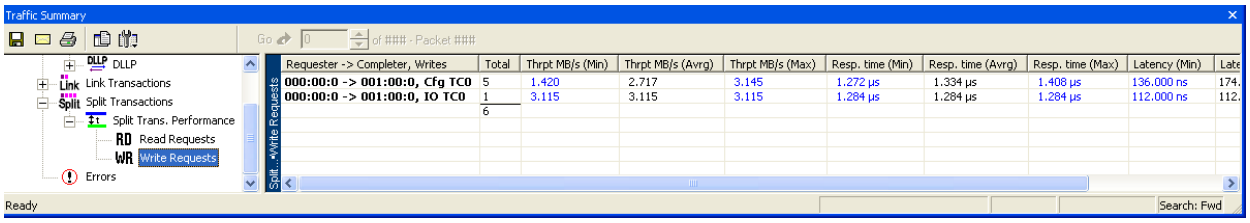
Split Transaction Performance: This report table groups the Split Transactions by Requester-Completer pair and displays Minimum/Average/Maximum data for Number Of Link Transactions and Response Time metrics.


Traffic Summary
All reports
Packets
Link Transactions
Split Transactions
Split Trans. Performance
Errors
Split Trans... - Performance
Requester -> Completer | Total | # LinkTras (Min) | # LinkTras (Avrg) | # LinkTras (Max) | Resp. time (Min) | Resp. time (Avrg) | Resp. time (Max)
002:00:0 -> 000:04:0 | 188456 | 2 | 2.00 | 2 | 284.000 ns | 448.040 ns | 1.204 µs
000:04:0 -> 002:00:0 | 54 | 2 | 2.00 | 2 | 720.000 ns | 802.880 ns | 1.060 µs
188510

Read Requests Performance: This report table includes only the Split Transactions that present Read Requests (Configuration, IO and Memory). It groups them by the combination of Requester-Completer pair, request type, and Traffic Class and displays Minimum/Average/Maximum data for Throughput, Response Time, and Latency metrics.


Traffic Summary
DLLP
Link Transactions
Split Transactions
Split Trans. Performance
RD Read Requests
WR Write Requests
Errors
Split...-Read Requests
Requester -> Completer, Reads | Total | Thrpt MB/s (Min) | Thrpt MB/s (Avrg) | Thrpt MB/s (Max) | Resp. time (Min) | Resp. time (Avrg) | Resp. time (Max) | Latency (Min)
000:00:0 -> 001:00:0, Cfg TC0 | 36 | 14.085 | 14.546 | 15.385 | 260.000 ns | 275.110 ns | 284.000 ns | 4.000 ns
000:00:0 -> 001:00:0, IO TC0 | 8 | 8.929 | 9.402 | 10.101 | 396.000 ns | 426.000 ns | 448.000 ns | 156.000 ns
44

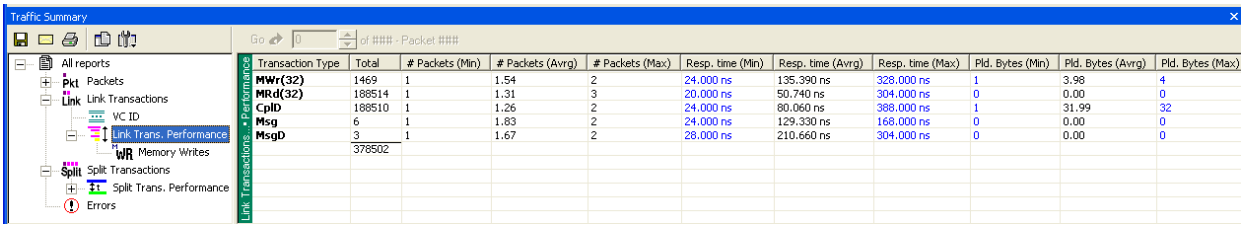
Write Requests Performance: This report table includes only the Split Transactions that present Write Requests (Configuration and IO). It groups them by the combination of Requester-Completer pair, request type, and Traffic Class and displays Minimum/Average/Maximum data for Throughput, Response Time, and Latency metrics.


Traffic Summary
DLLP
Link Transactions
Split Transactions
Split Trans. Performance
RD Read Requests
WR Write Requests
Errors
Split...-Write Requests
Requester -> Completer, Writes | Total | Thrpt MB/s (Min) | Thrpt MB/s (Avrg) | Thrpt MB/s (Max) | Resp. time (Min) | Resp. time (Avrg) | Resp. time (Max) | Latency (Min)
000:00:0 -> 001:00:0, Cfg TC0 | 5 | 1.420 | 2.717 | 3.145 | 1.272 µs | 1.334 µs | 1.408 µs | 136.000 ns
000:00:0 -> 001:00:0, IO TC0 | 1 | 3.115 | 3.115 | 3.115 | 1.284 µs | 1.284 µs | 1.284 µs | 112.000 ns
6
Ready
Search: Fwd

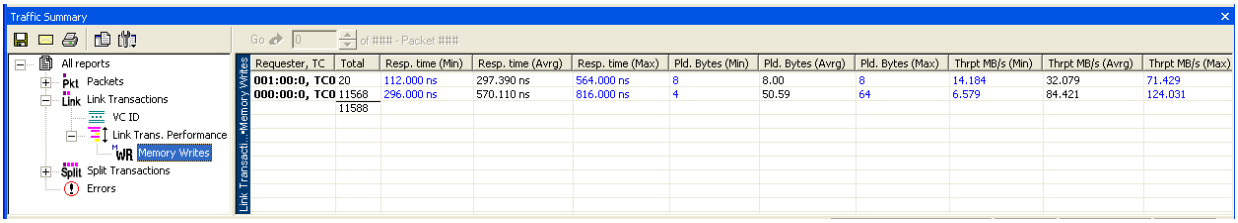
Reports at the Link Transaction Level

The following metric-based reports are displayed at the Link Transaction level:

Link Transaction Performance: This report table groups the Link Transactions by TLP Type and displays Minimum/Average/Maximum data for Number Of Packets, Response Time and Payload Bytes metrics.


Traffic Summary
All reports
Packets
Link Transactions
VC ID
Link Trans. Performance
Memory Writes
Split Transactions
Split Trans. Performance
Errors
Link Transactions - Performance
Transaction Type | Total | # Packets (Min) | # Packets (Avrg) | # Packets (Max) | Resp. time (Min) | Resp. time (Avrg) | Resp. time (Max) | Pld. Bytes (Min) | Pld. Bytes (Avrg) | Pld. Bytes (Max)
MWr(32) 1469 1 1.54 2 24.000 ns 135.390 ns 328.000 ns 1 3.98 4
MRd(32) 188514 1 1.31 3 20.000 ns 50.740 ns 304.000 ns 0 0.00 0
CplD 188510 1 1.26 2 24.000 ns 80.060 ns 388.000 ns 1 31.99 32
Msg 6 1 1.83 2 24.000 ns 129.330 ns 168.000 ns 0 0.00 0
MsgD 3 1 1.67 2 28.000 ns 210.660 ns 304.000 ns 0 0.00 0
378502

Memory Writes: This report table includes only the Link Transactions that present Memory Write Requests. Memory Writes are the only (posted) requests that don't get promoted to the Split transaction level, therefore their performance should be viewed at the Link transaction level. The table groups Memory Writes by the combination of Requester ID and Traffic Class and displays Minimum/Average/Maximum data for Response Time, Payload and Throughput metrics.


Traffic Summary
All reports
Packets
Link Transactions
VC ID
Link Trans. Performance
Memory Writes
Split Transactions
Errors
Link Transacti...Memory Writes
Requester, TC | Total | Resp. time (Min) | Resp. time (Avrg) | Resp. time (Max) | Pld. Bytes (Min) | Pld. Bytes (Avrg) | Pld. Bytes (Max) | Thrpt MB/s (Min) | Thrpt MB/s (Avrg) | Thrpt MB/s (Max)
001:00:0, TC0 20 112.000 ns 297.390 ns 564.000 ns 8 8.00 8 14.184 32.079 71.429
000:00:0, TC0 11568 296.000 ns 570.110 ns 816.000 ns 4 50.59 64 6.579 84.421 124.031
11588

Following features apply to all of the report tables described above for the Split Transaction and Link Transaction levels:

- Each report row for the defined tables contains the total number of units in this group for the CATC Trace (total number of units for Split Transaction performance, Read Requests performance, Memory Writes, and so on).
- In many cases, the Maximum and Minimum values in the report tables are navigable. By clicking table cells, you reposition the corresponding CATC Trace view to the Split or Link Transaction that has yielded this maximum or minimum value. This can help you to find specific units in the CATC Trace, such as transactions that produced spikes in Response Time or Throughput.

Show Metrics in the Bus Utilization Window

The Bus Utilization window provides graphs for packet-level information in the CATC Trace. The window also provides graphs for information on Split and Link Transaction levels, plotted over time. The graphs for Split and Link Transaction levels are based on metrics collected for the transactions throughout the CATC Trace.

The seven graphs related to Split and Transaction levels are:

1. Pending Requests at Split Transaction level.
2. Response Time at Split Transaction level.
3. Latency Time at Split Transaction level.
4. Throughput Per Transaction at Split Transaction level.
5. Response Time and Latency Time at Split Transaction level (combined graph).
6. Response Time at Link Transaction level, for Memory Writes only.
7. Throughput at Link Transaction level, for Memory Writes only.

The following is an example of Bus Utilization window display of graph numbers 1, 4, 5, 6 and 7:

Unit-Based Averaging

The Analyzer builds metric graphs using unit-based averaging (as opposed to time-based averaging). For the total duration of a certain request (or Memory Write transaction), the graph value is assumed equal to the corresponding metric for this request (transaction). If there are overlapping operations for a certain time period, then the value is calculated as an average of metric values for all the overlapped requests (transactions).

It is important to remember that the Analyzer uses unit-based averaging rather than time-based averaging. Time-based averaging can be misleading in some situations. For example, consider the Throughput Per Transaction graph. Sometimes, while many outstanding requests are in progress, latency (and response time) grows for each of the transactions, resulting in a lower throughput per transaction over time (which is reflected in the graph). This happens even though aggregated throughput across all the transactions is constant.

Bus Utilization Window Features

For the seven Split- and Transaction-level graphs listed, all Bus Utilization window features are available, such as zooming in/out, changing scale type, scrolling, context-sensitive status, and graph synchronization. See Bus Utilization and Bus Utilization Buttons for more on these features.

Note: Clicking a certain place within a graph area repositions the CATC Trace display at the Link or Split transaction level to the transaction that was in progress at that time.

Split Transaction Level Graphs

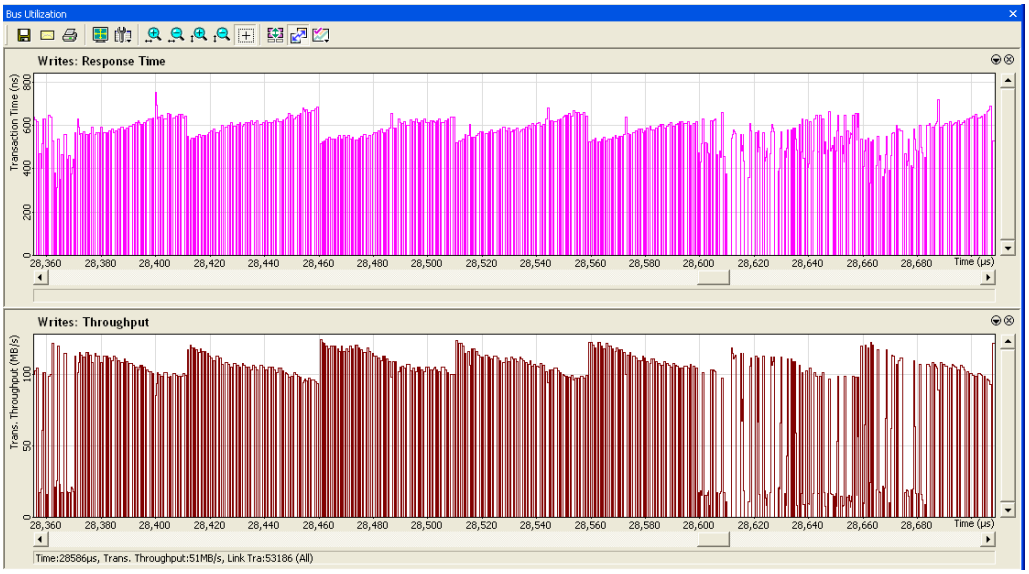
Transactions at the Split level combine all the non-posted requests with corresponding completions. This includes Configuration and IO Read and Write requests, as well as Memory Read requests.

The following shows the graphs for the Split level:

Note: The Pending Requests graph is not directly defined by metrics, but it is useful when considering metrics. The Pending Requests graph presents the unit-averaged number of requests that were pending (in progress) at any moment of time. It allows you to correlate the number of requests posted to a completer with other performance metrics.

Link Transaction Level Graphs

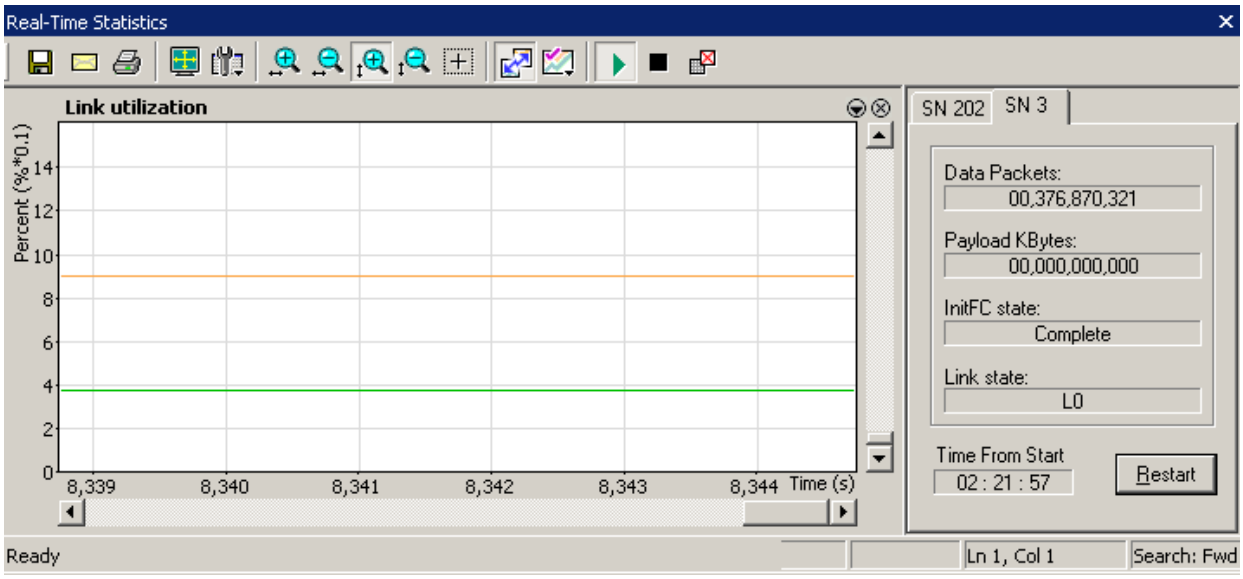
Memory Writes are the only (posted) requests that do not get promoted to the Split transaction level. Therefore, Memory Write performance should be viewed at the Link Transaction level. That is the reason graphs at the Link level only present the Memory Write-related metrics and are titled **Writes: Response Time:** and **Writes: Throughput**.



9.13 Real-Time Statistics Window

The Real-Time Statistics Window displays Link Utilization, performance measurements, and statistical values for a PCI Express link plotted in real time.

Click to open the Real-Time Statistics window.



Start **PCI Express™** link activity.

To start the monitor, press .

To stop the monitor, press .

The remaining Real-Time Statistics buttons provide options for changing the format of the display.

Additional formatting options are available through the Real-Time Statistics pop-up menu and the Real-Time Statistics toolbar.

Real-Time Statistics Buttons

Additional formatting options are available through the Real-Time Statistics toolbar.

Button	Function
	Save. Saves Real-Time Statistics data to bitmap file (*.bmp).
	Email. Opens an email and attaches a bitmap file of the Real-Time Statistics data.
	Print. Prints the Real-Time Statistics data.
	Full Screen. Maximizes the Real-Time Statistics window.
	View Settings. Opens a sub-menu with the following choices: • Orient Horizontally • Tile Vertically • Show Markers • Show Plumbline • Status >> Bar Tool tips None • Grid Lines >> Both Axes X Axis Y Axis No Grid • Grid on Top • Fonts & Colors
	Horizontal zoom in
	Horizontal zoom out

Vertical zoom in

Vertical zoom out

Click and Drag Zoom. Click and drag to zoom in on a part of the graph.

Synchronize Graph Areas. If two or more graphs are displayed, this button synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.

Graph Areas. Allows you to hide or display the graphs and the counters. You can toggle Statistics Accumulation, Link Utilization, Data Payload Throughput, and Data Packet Count.

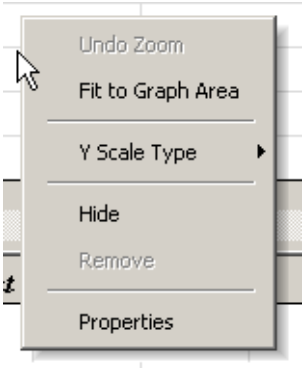
Start real-time statistics. Starts the real-time statistical monitor.

Stop real-time statistics. Stops the real-time statistical monitor.

Reset Graphs. Resets the graphs.

Real-Time Statistical Monitor Pop-up Menu

Additional formatting options are available through the Real-Time Statistics pop-up menu. Right-click a graph in the Real-Time Statistical Monitor window to display a pop-up menu with options for changing the format of the display.



Undo Zoom: If you have zoomed in, this command undoes the zoom.

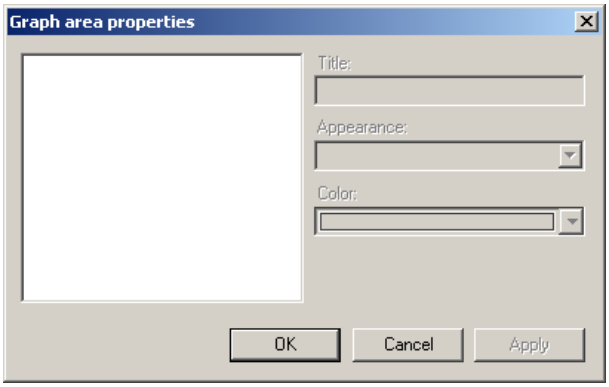
Fit to Graph Area: Redisplays graph so that the entire CATC Trace fits inside graph area.

Y Scale Type:

- **Linear**: Converts display to linear format.
- **Logarithmic**: Converts display to logarithmic format.

Hide: Hides the selected graph

Properties: Opens a dialog box with options for changing the Title, Appearance, and Color of the graph.



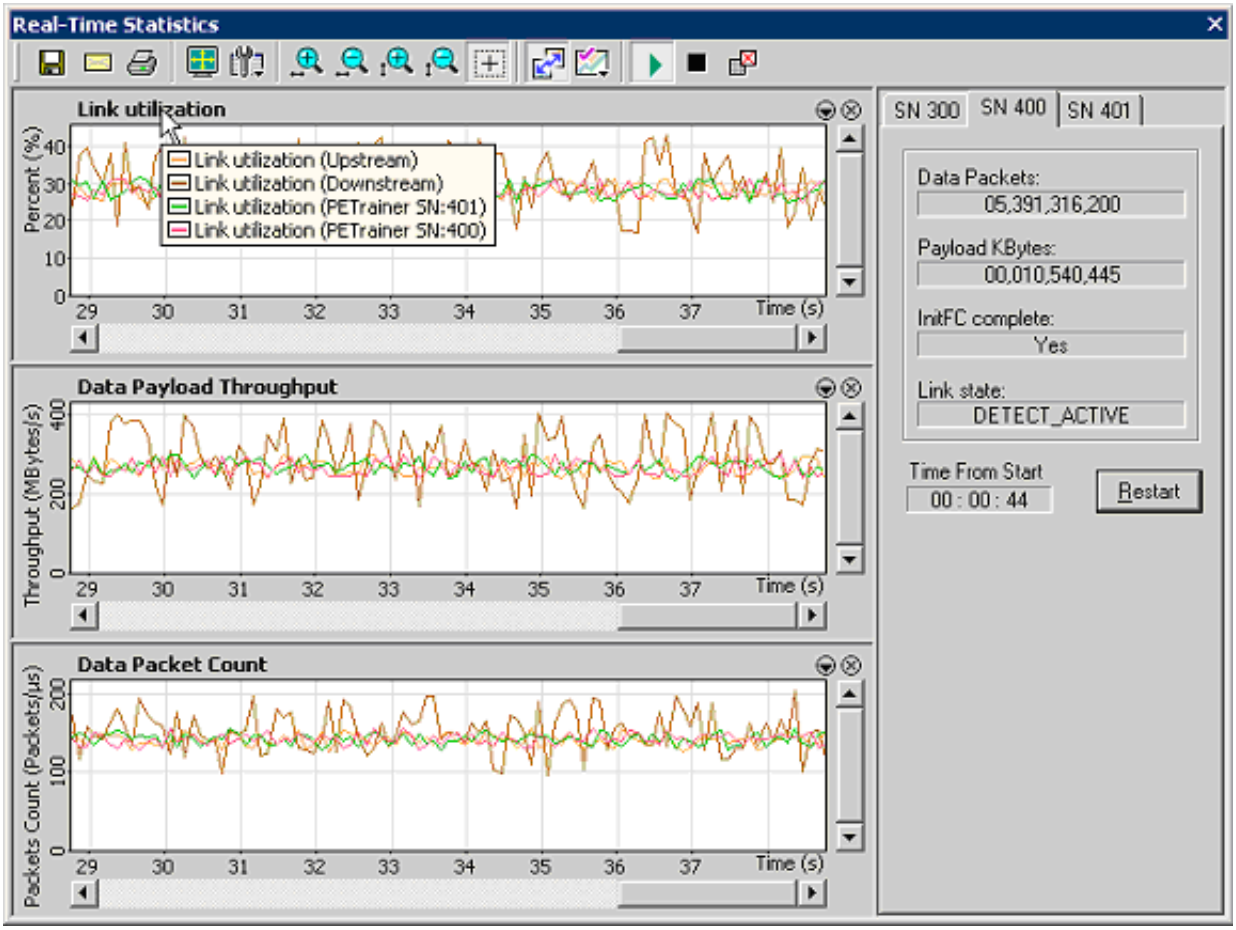
Real-Time Statistics Graph Areas

The Real-time Statistics window has three graph areas:

- Link Utilization
- Data Payload Throughput
- Data Packet Count

Each graph area has Upstream and Downstream graphs for a PE*Tracer* device (if connected to a host machine), plus as many graphs as PE*Trainer*™ devices connected to the host machine.

The Statistics Accumulation area shows the PE*Tracer* statistics tab, plus as many tabs as PE*Trainer* devices connected:

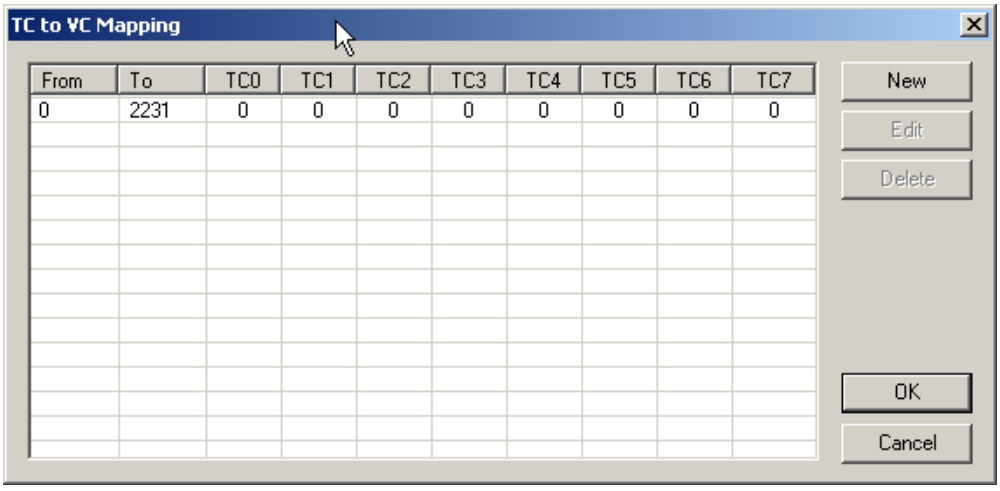


For each PE*Trainer* device the following information displayed:

- **Number of data packets**
- **Payload size**
- **InitFC complete status**: Yes/No
- **Link State**: Possible states are:
  - DETECT_QUIET
  - DETECT_ACTIVE
  - POLLING_ACTIVE
  - POLLING_CONFIG
  - CONFIG_LINKWIDTH_START
  - CONFIG_LINKWIDTH_ACCEPT
  - CONFIG_LANENUM_WAIT
  - CONFIG_LANENUM_ACCEPT
  - CONFIG_COMPLETE
  - CONFIG_IDLE
  - L0
  - L0S_IDLE
  - L0S_FTS
  - L1
  - RECOVERY_RCVRLOCK
  - RECOVERY_RCVRCFG
  - RECOVERY_IDLE
  - HOT_RESET
  - DISABLED

9.14 TC to VC Mapping

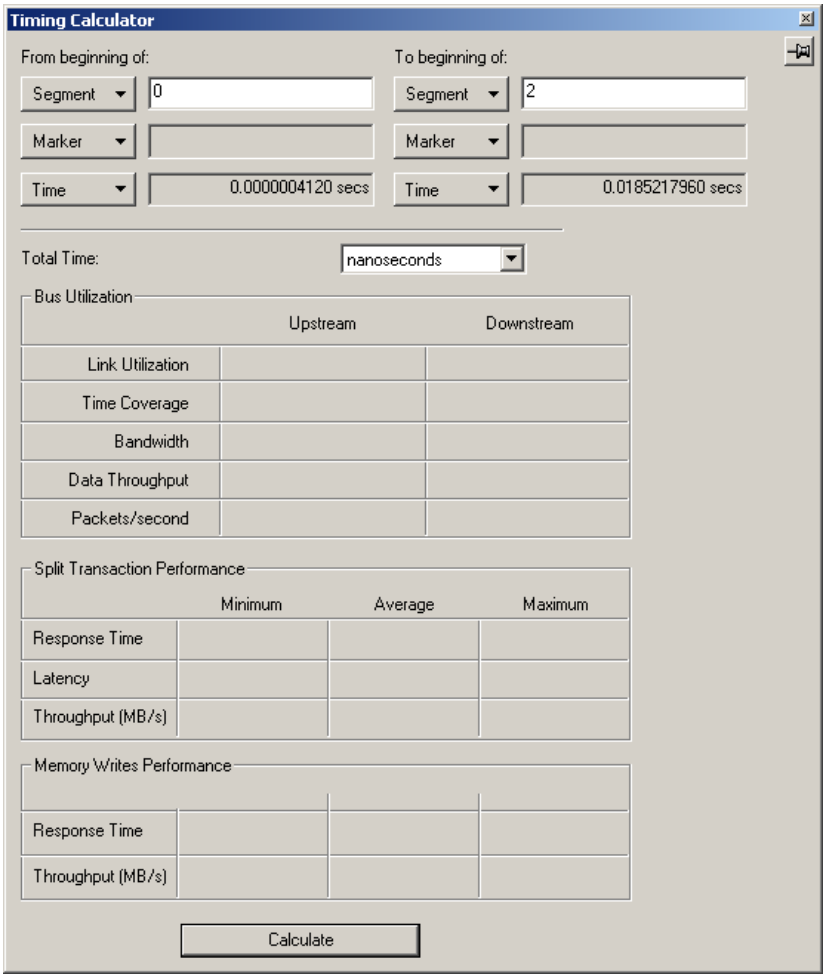
TC to VC Mapping displays how Traffic Classes are mapped to Virtual Channels (to simplify navigation) and how the CATC Trace display was changed (for example, in Split Transactions).



9.15 Timing and Bus Usage Calculations

The Timing and Bus Usage Calculator allows you to calculate time between packets.

Select **Reports > Timing Calculations** to obtain the Timing Calculator dialog box.



Total Time: Total time from beginning of the first unit to beginning of the second unit.

Bus Utilization

This portion of the Timing Calculator window gives values that are cumulative for all packets during the timing period. For example, throughput is combined throughput of all packets during the timing period.

Upstream is from endpoint devices to the root complex. Downstream is from the root complex to endpoint devices.

Link Utilization: Percentage of non-idle symbols in total number of symbols transferred.

Time Coverage: Percentage of non-idle symbol times in total number of symbol times. (Non-idle symbol time occurs when at least on one of the lanes there were non-idle symbols transferred.)

Bandwidth: Number of non-idle symbol bits transferred per second.

Data Throughput: Number of TLP payload bytes transferred per second.

Packets/second: Number of packets transferred per second.

Split Transaction Performance

This portion of the Timing Calculator window gives minimum, maximum, and average values for all Split transactions during the timing period. For example, minimum throughput is throughput of the Split transaction that passes the least amount of data. Maximum throughput is throughput of the Split transaction that passes the most amount of data. Average throughput is the average calculated for all Split transactions during the timing period.

Response Time: The time it took to transmit this Split transaction on the PE link, from the beginning of the first packet in the Split transaction to the end of the last packet in the Split transaction.

Latency: The time measured from the end of the request transaction to the first completion transmitted in response to the request within this Split transaction.

Throughput: The transaction payload divided by response time, expressed in megabytes per second.

Memory Writes Performance

This portion of the Timing Calculator window gives minimum, maximum, and average values for all Memory Write transactions during the timing period. For example, minimum throughput is throughput of the Memory Write transaction that passes the least amount of data. Maximum throughput is throughput of the Memory Write transaction that passes the most amount of data. Average throughput is the average calculated for all Memory Write transactions during the timing period.

Response Time: The time it took to transmit this Memory Write on the PE link, from the beginning of the first packet in the Memory Write to the end of the last packet in the Memory Write.

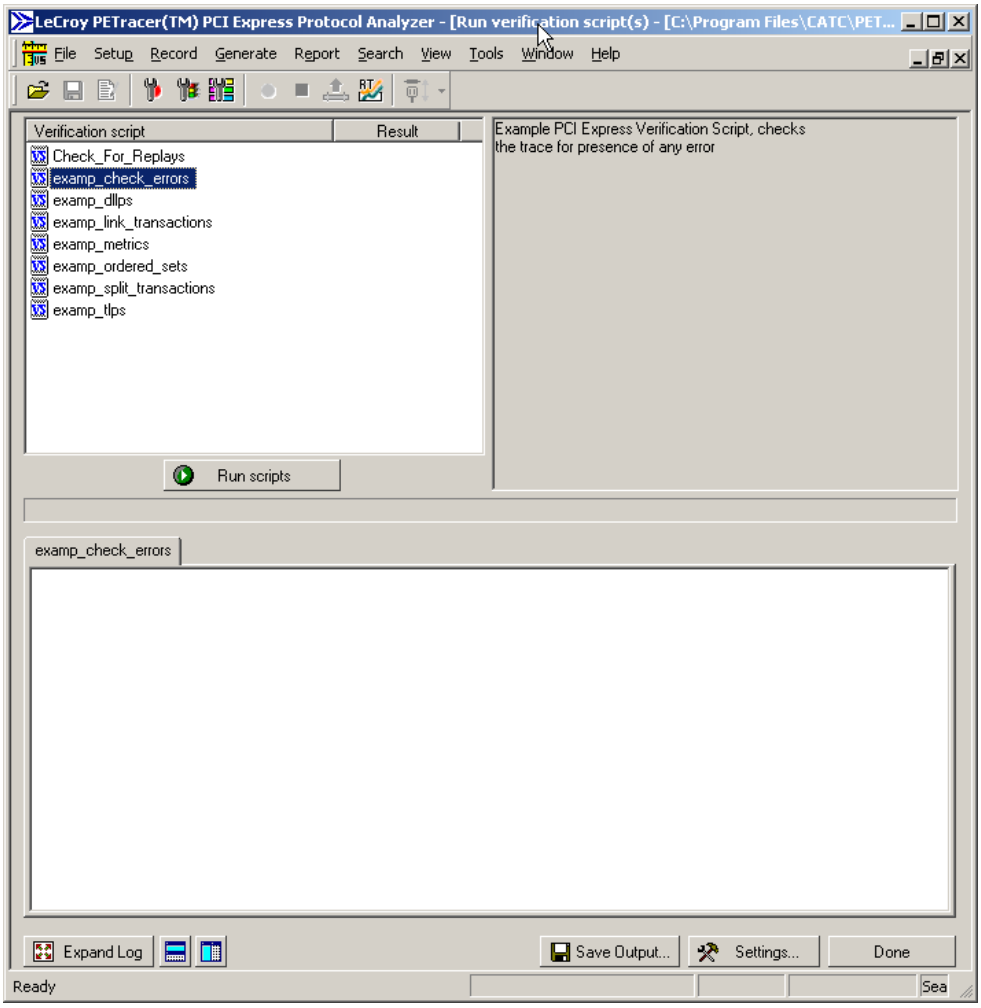
Throughput: The Memory Write payload divided by response time, expressed in megabytes per second.

9.16 Running Verification Scripts

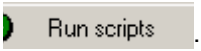
You can run verification scripts to check errors, link transactions, split transactions, metrics, ordered sets,replays, DLLPs, and TLPs.

To obtain the Verification Script dialog box, select **Tools > Run verification scripts**

or click the icon.

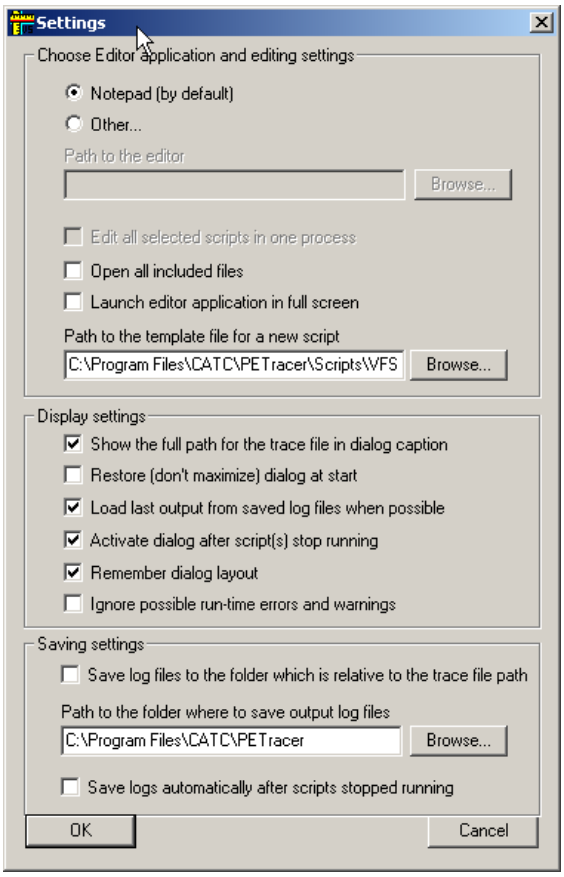


The available verification scripts are in the Verification script section.

To run a script, select it, then click the **Run Scripts** button  .

The results appear in the bottom window. You can expand or collapse this window. You find a view related to the CATC Trace and place this window under or to the right of it. You can Save the results.

Click the **Settings** button to display the Settings window.


Settings
Choose Editor application and editing settings
Notepad (by default)
Other...
Path to the editor
Browse...
Edit all selected scripts in one process
Open all included files
Launch editor application in full screen
Path to the template file for a new script
C:\Program Files\CATC\PETracer\Scripts\VFS
Browse...
Display settings
Show the full path for the trace file in dialog caption
Restore (don't maximize) dialog at start
Load last output from saved log files when possible
Activate dialog after script(s) stop running
Remember dialog layout
Ignore possible run-time errors and warnings
Saving settings
Save log files to the folder which is relative to the trace file path
Path to the folder where to save output log files
C:\Program Files\CATC\PETracer
Browse...
Save logs automatically after scripts stopped running
OK
Cancel

You can choose the editor, display settings, and saving settings.

Section 3. PE*Trainer* Exerciser Traffic Generation

Chapter 10: Traffic Generation

PE*Trainer*™ is a traffic generator that can emulate PCI Express™ root complexes and endpoint devices. Traffic generation can be used to transmit known errors, allowing you to observe how your device handles faulty link conditions.

After the PE*Trainer*™ ML™ and DUT have been cabled and powered on, you can test the setup by generating some traffic. The following steps show how to configure the Exerciser to generate a Link Training sequence.

10.1 Theory of Operation

Overview

PE*Trainer* offers two mechanisms for implementing traffic generation: scripts, in which any type of traffic can be defined and executed, and the Generation Options dialog box, which offers a collection of PCI Express specific **behaviors** that can be enabled for automatic generation of traffic.

Using scripts, packets can be transmitted one after another or with certain timing or event-based pauses between them. This allows the PE*Trainer* to act as a pattern generator with PCI Express-specific formatting and transmission rates. However, creating traffic that emulates real devices with relatively complex protocol behaviors using a simple pattern generator is quite complicated. Certain behaviors such as ACK policies, and flow control require concurrent processing. This is where the automated features of the PE*Trainer* ML™ products become useful.

The PE*Trainer* includes a collection of automated traffic generation circuits that commonly exist in other PCI Express devices. These circuits include ACK/NAK generation, flow control management, a Link Training and Status State machine (LTSSM), replay buffers, and transaction timers. What makes the PE*Trainer* unique and so useful is that each of these behaviors can be individually modified or disabled. This allows the user to perform operations that might not otherwise be possible using an off the shelf PCI Express device. This can be particularly useful when doing compliance or fault recovery testing.

Starting Point

When the PE*Trainer* first powers up, it is at electrical idle on all lanes. The link is not trained, but the Link Training and Status State Machine (LTSSM) is enabled and waiting for a command to train the link. To begin communication with a PCI Express device, the Link training must occur, but first the generation settings must be set. This involves setting the Link parameters such as link width, polarity inversion, and lane reversal, through the Generation Options dialog.

Note: Setting the options in the Generation Options dialog has no effect on the PE*Trainer* behavior until the first script is executed. In fact, each time a script is executed, these behaviors are reprogrammed to the PE*Trainer* and the behaviors are modified accordingly.

The **Link Connect** toolbar button can then be pressed to signal to the LTSSM to initiate Link training. Alternatively, a script can executed with the **Link=L0** command.

The PE*Trainer* Status bar at the bottom of the screen shows the current state of the PCI Express Link. When the Link is down, it shows **Detect**. When it is up, it shows **L0**.

All of the intermediate link states, such as **Polling** and **Configuration**, are handled automatically. In fact, after the **Link=L0** command is executed and the LTSSM is alive, the PE*Trainer* attempts to keep the Link active just as any other PCI Express device does. This includes handling of Recovery states and subsequent retraining events.

The next step is to enable flow control. This is done by executing the **Link=InitFC** command. This causes PE*Trainer* to perform flow control initialization and, if enabled, begin periodic transmission of **Update_FC DLLP**'s. If the Link connect toolbar button was used, the flow control initialization happens automatically.

By using these basic commands, the complicated process of link training is managed automatically. The Link is now trained and the script execution can now focus on sending TLP packets.

Script Execution

As mentioned above, each time a script is executed, the configuration settings for the PE*Trainer* are reprogrammed. When the **Start generation** button is pressed, the script is uploaded to the PE*Trainer* hardware and executed immediately. Progress of the script can be tracked in the status bar at the bottom of the screen. Subsequent executions of the same script do not require upload of the script to the PE*Trainer*, however, as mentioned above, the generation options are still reprogrammed.

Script execution can be throttled using **Wait** commands inserted directly into the script. Waits can be time based, require receipt of certain packet types, or can even require **User** input from the GUI.

After the script is complete, any enabled PCI Express **behaviors,** such as SKIP insertion, Flow control, and ACK generation, continue. This allows you to run multiple scripts, one after another, without interrupting the Link state.

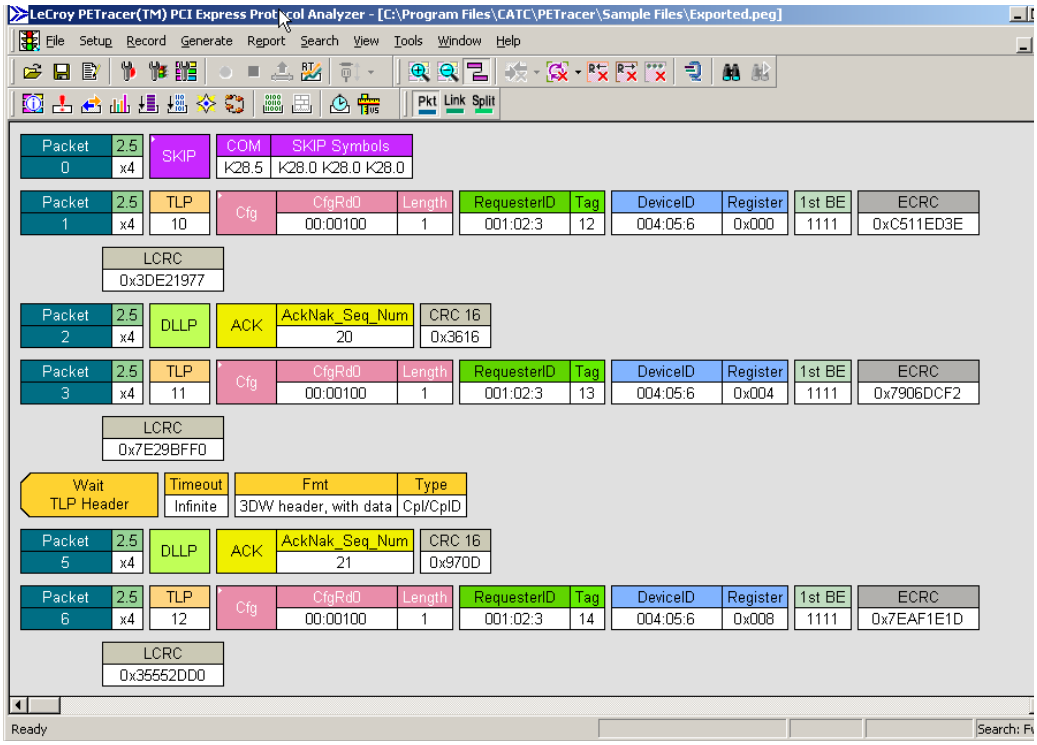
10.1 Traffic Generation Files

The **.peg** traffic generation files are text files consisting of a series of commands from a scripting language (see Chapter 12), and optionally, one or more **Include** statements linking other generation files into the current file.

```
packet = OrderedSet {
    SetType = Skip
    SkipCount = 0x3
}
packet = TLP {
    PSN = 0xA
    TLPType = CfgRd0
    TC = 0x0
    TD = 0x1
    EP = 0x0
    Ordering = 0x0
    Snoop = 0x0
    Length = 0x1
    RequesterID = (1:2:3)
    Tag = 0xC
    LastDwBe = 0x1
    FirstDwBe = 0xF
    DeviceID = (4:5:6)
    Register = 0x0
    ECRC = 0xC511ED3E
    LCRC = 0x3DE21977
}
```

Note: To edit a generation file, use the Script Editor, a specially designed text editor tool. See “Editing Generation Files with the Script Editor” on page 210.

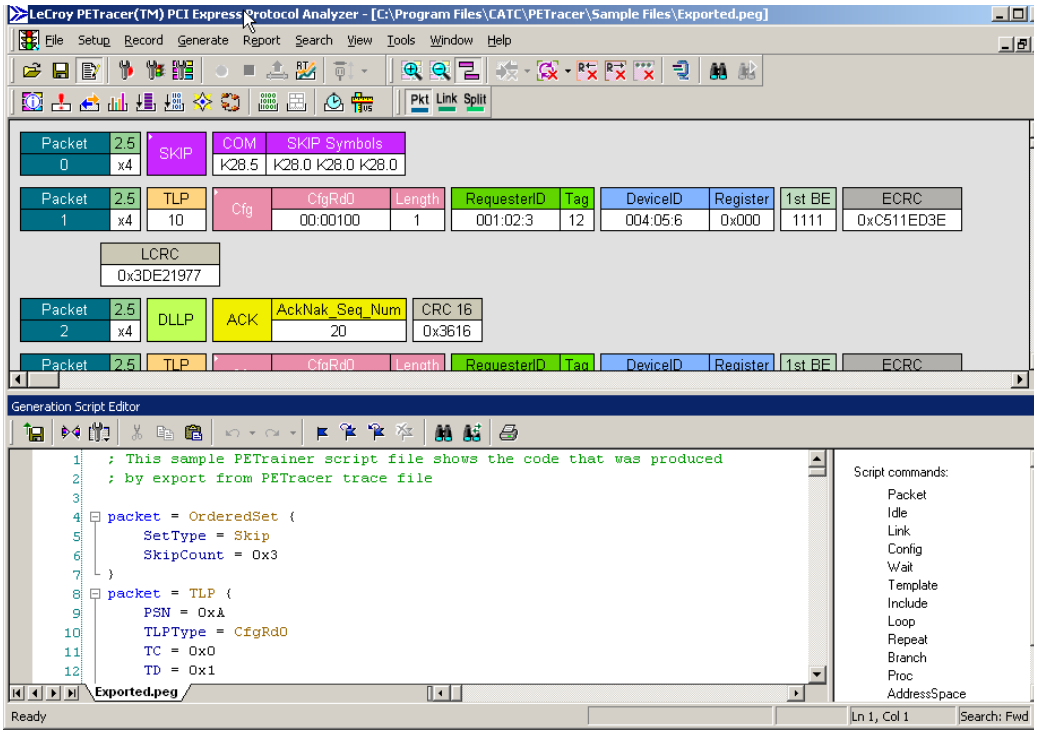
To generate traffic, open a traffic generation file (***.peg**) and then run it.


LeCroy PETracer(TM) PCI Express Protocol Analyzer - [C:\Program Files\CATC\PETracer\Sample Files\Exported.peg]
File Setup Record Generate Report Search View Tools Window Help
Pkt Link Split
Packet 0 2.5 x4 | SKIP | COM K28.5 | SKIP Symbols K28.0 K28.0 K28.0
Packet 1 2.5 x4 | TLP 10 | Cfg | CfgRd0 00:00100 | Length 1 | RequesterID 001:02:3 | Tag 12 | DeviceID 004:05:6 | Register 0x000 | 1st BE 1111 | ECRC 0xC511ED3E
LCRC 0x3DE21977
Packet 2 2.5 x4 | DLLP | ACK | AckNak_Seq_Num 20 | CRC 16 0x3616
Packet 3 2.5 x4 | TLP 11 | Cfg | CfgRd0 00:00100 | Length 1 | RequesterID 001:02:3 | Tag 13 | DeviceID 004:05:6 | Register 0x004 | 1st BE 1111 | ECRC 0x7906DCF2
LCRC 0x7E29BFF0
Wait TLP Header | Timeout Infinite | Fmt 3DW header, with data | Type Cpl/CplD
Packet 5 2.5 x4 | DLLP | ACK | AckNak_Seq_Num 21 | CRC 16 0x970D
Packet 6 2.5 x4 | TLP 12 | Cfg | CfgRd0 00:00100 | Length 1 | RequesterID 001:02:3 | Tag 14 | DeviceID 004:05:6 | Register 0x008 | 1st BE 1111 | ECRC 0x7EAF1E1D
LCRC 0x35552DD0
Ready

When the file is opened, it appears in the CATC Trace window looking like a CATC Trace file.

To run the file, press .

To create or edit a **.peg** file, use the Script Editor.



The Script Editor is a text-editing tool that can be opened by clicking .

Alternatively, the traffic generation file can be created by exporting the data from a CATC Trace into a traffic generator file.

10.2 Creating a Traffic Generation File

There are four ways to create PE*Trainer*™ traffic generation script file:

- **Export an existing PE*Tracer*™ trace** to a PE*Trainer* script file
- **Save an existing PE*Trainer* script** to a new file
- **Select File > New** to create a new and empty script file that contains no text.
- **Create an empty file** using an OS shell (with **.peg** extension) and open it with PE*Tracer* software.

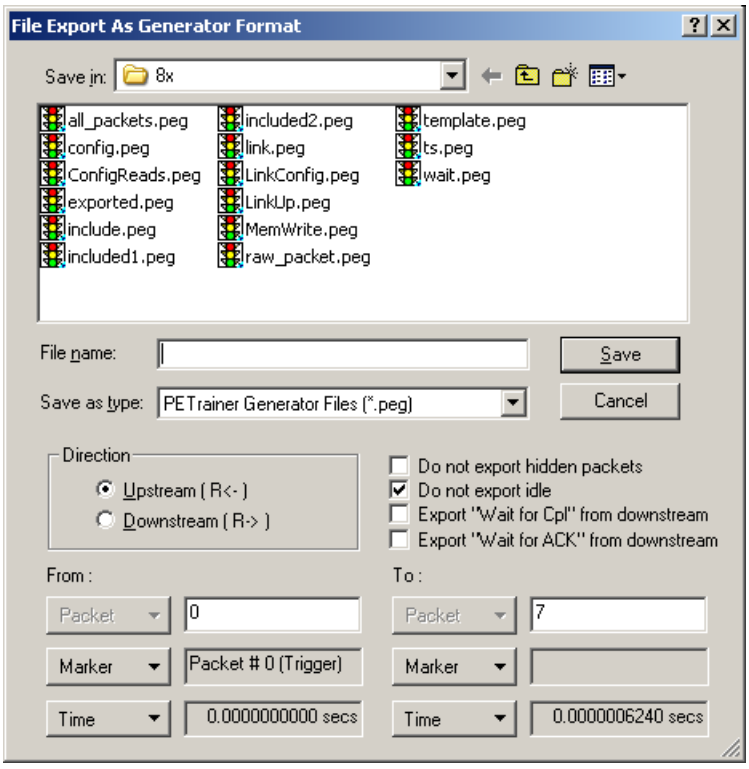
Exporting a CATC Trace to a Traffic Generation File

A simple way to create a script file is to open a CATC Trace and then to export the CATC Trace data to a generation file:

Step 1 Open a CATC Trace file.

Step 2 Select **File > Export > to Generator File Format**.

Step 3 Select the desired options from the File Export dialog box:



Direction: Selects the direction of the traffic to be exported.

From and To: Selects a range for exporting. You can export all or part of the CATC Trace.

Do not export hidden packets: Ignores any packets hidden through the various hide options.

Do not export Idle packets: Excludes Idles from the export.

Export "Wait for Cpl" from upstream: Exports all **Wait for Completions** from the opposite direction. **Wait = TLP** is a PE*Trainer* script command.

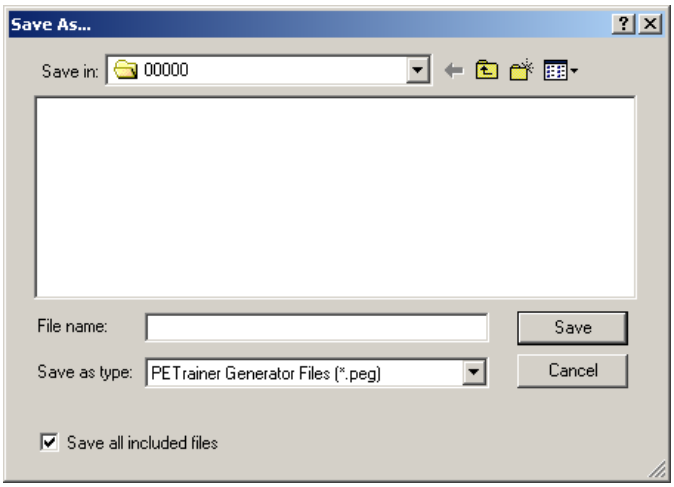
Export "Wait for ACK" from upstream: Exports all **Wait for ACK DLLPs** from the opposite direction.

Saving a PE*Trainer* Script to a New File

To save a script file as a generation file:

Step 1 Open an existing PE*Trainer* script file.

Step 2 Select **File > Save As**… or click on the toolbar.



Step 3 Navigate to the desired folder and type a new file name where you want to save the current script, then click the **Save** button:

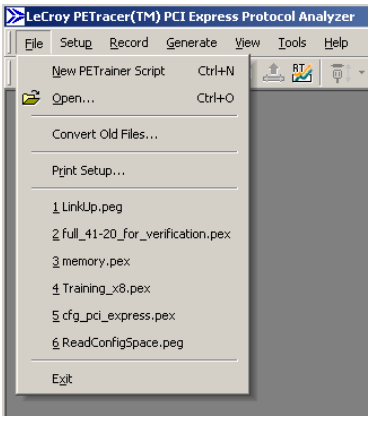
When the Save As command completes, the newly created script is displayed.

Note: The Save As dialog box includes the option **Save all included files**. This option causes the software to save any **Include** files that have included into the script. The Included files are saved to the same directory as the traffic generation file.

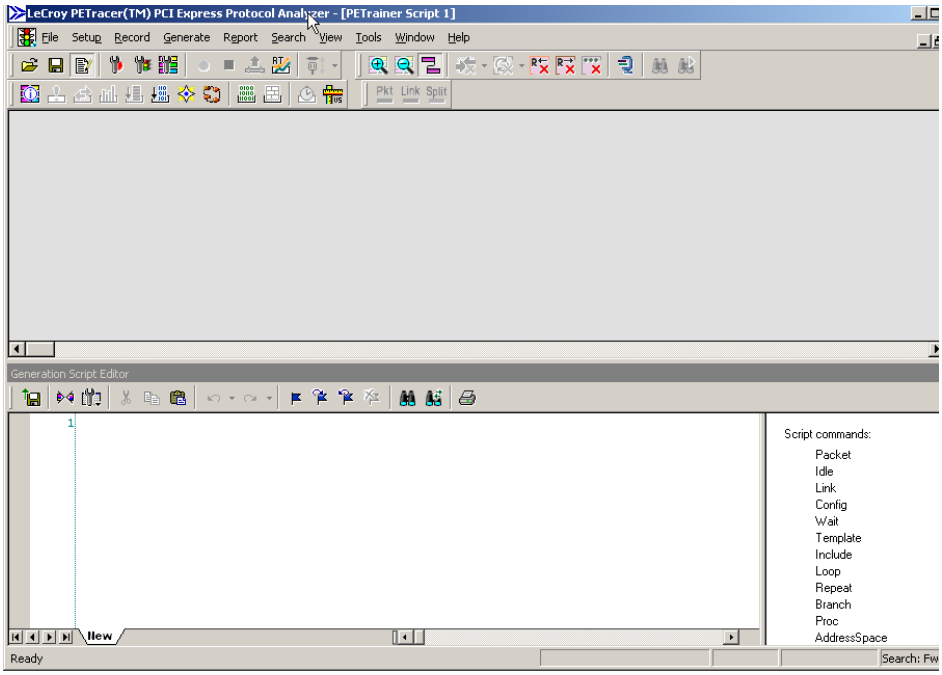
Creating a New Empty Generation File

To create a generation file from scratch:

Step 1 Select **File > New PE*Trainer* Script** or use the shortcut **Ctrl+N**.



An empty PE*Trainer* traffic generation file appears. You can also view the Script Editor.

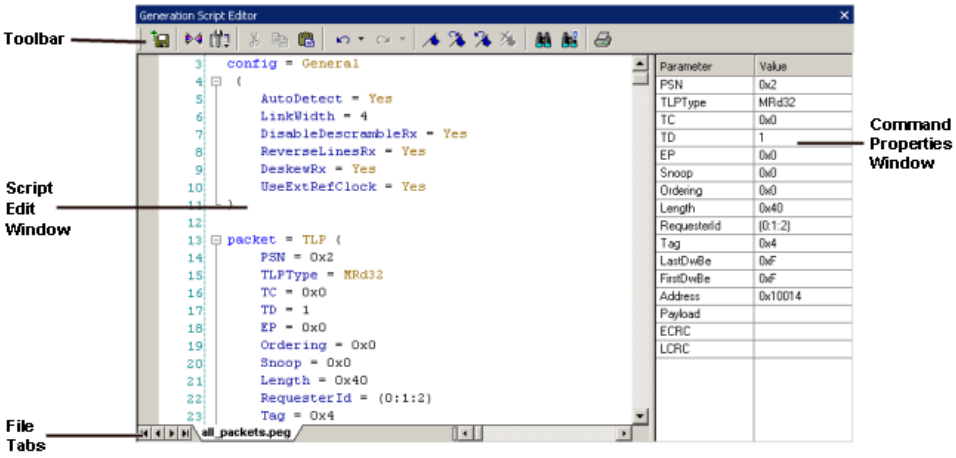


10.3 Editing Generation Files with the Script Editor

The Script Editor is an editing tool for PE*Tracer* traffic generation files (**<filename>.peg**). The generation script is presented in the Script Edit window. Parameters are presented in menus and text boxes in the Command Properties window in the right-hand portion of the Script Editor.

To launch the Script Editor: click the **Script Editor** button on the toolbar or right-click the CATC Trace window and choose **Edit as Text** from the pop-up menu.

The Script Editor window displays in the lower portion of the CATC Trace window.



Layout: The Script Editor divides into four areas:

- **Script Editor toolbar**: Presents options for printing, saving, bookmarking, and other options.
- **Script Edit window**: Main window where the script is displayed and edited. Text in this window behaves as in most text editors. Text can be copied, pasted, and searched.
- **Command Properties window**: Presents editable parameters. Many parameters have menus. Click the parameter in the Command Properties window to see if a down-arrow appears.
- **File tabs**: Lists the name of the traffic generation file and any open **Include** files that are associated with the generation file. If the generation file has **Include** statements, the **Include** files automatically open and display as tabs in the File tabs section of the Editor window.

Error Log: An error log opens automatically at the bottom of the window any time a script error occurs. The window closes automatically whenever the error is corrected, after you save the script.

Script Editor Toolbar

The toolbar contains buttons for saving your edits, navigating, searching and other functions.

Save. Saves your edits and immediately updates the setting bars and Frames shown in the CATC Trace window.

Go to Trace View.
Causes trace view to bring the currently selected script line to the top of the screen.

View Options. Opens a menu with three options:

- Enable Outlining
- Toggle Outlining
- Line Numbers.

See “View Options Menu” on page 216 for descriptions.

Cut.

Copy.

Paste.

Undo.

Redo.

Toggle Bookmark. Allows markers to be set or removed to aid in navigation.

Next Bookmark.

Previous Bookmark.

Clear All Bookmarks.

Find.

Replace. Find and replace.

Print.

Script Edit Window

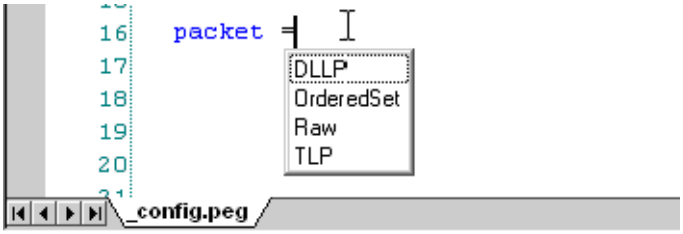
The Script Edit Window offers several features to simplify the process of editing.

Syntax Highlighting

All known commands and parameters are highlighted in **blue**.

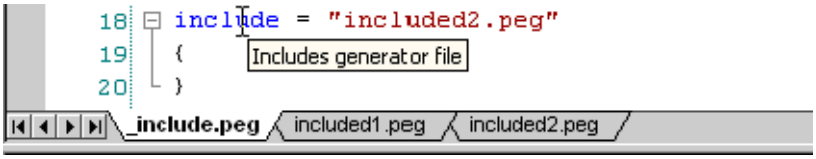
All predefined values and command modifiers are highlighted in **brown**.

Intellisense prompts for known predefined values/literals. This functionality is invoked when you type **=** after a known key or select **List values** from the Context menu.



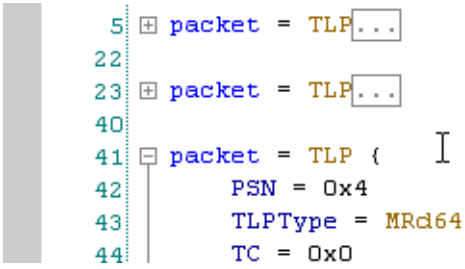
Tooltips

The Tooltips look like the following:



Outlining

When outlining is enabled user have the option to **collapse/expand** code blocks:



Text Editing Commands

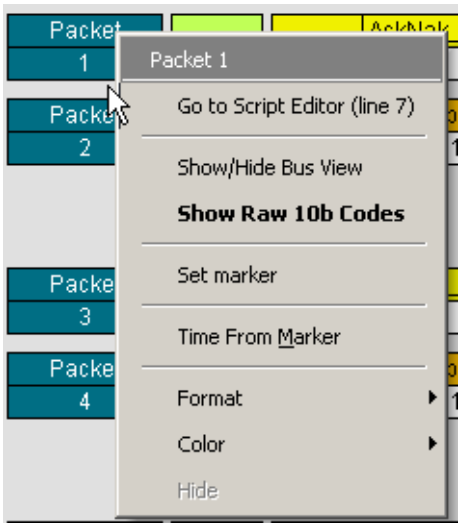
The Script Editor supports standard editor commands:

- Copy/Paste
- Undo/Redo
- Find/Replace
- Bookmarks

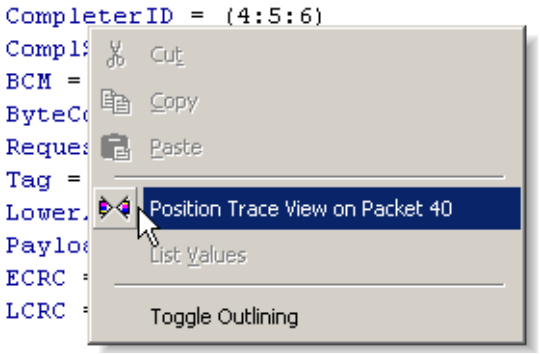
Synchronized Scrolling with the CATC Trace Window

You can navigate from the generation code window to the corresponding place in the CATC Trace representation, and visa versa.

From the CATC Trace window, right-click the **first cell in a packet** in the CATC Trace window and select **Go to Script Editor** from the pop-up menu. The Script Editor window then repositions to the corresponding code.

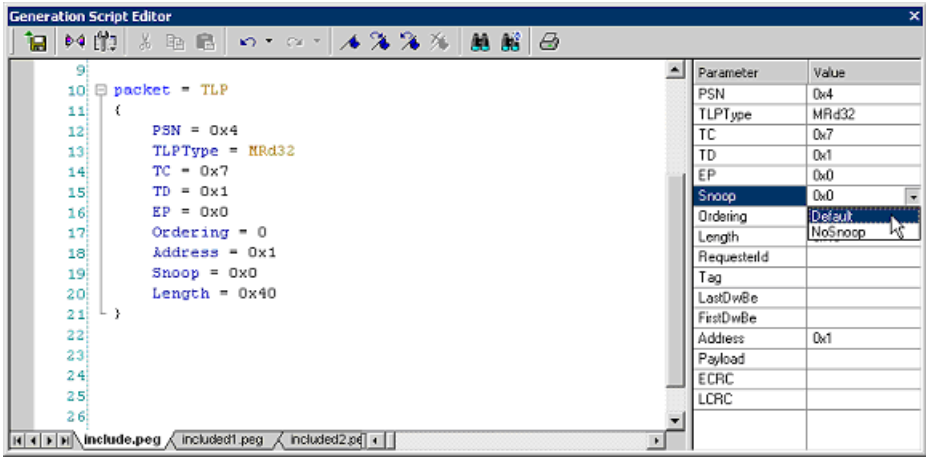


From the script editor, right-click some **code** within the Script Editor window and select **Position Trace view on packet x** from the pop-up menu (where **x** is a packet number). The CATC Trace window repositions to the corresponding packet number.

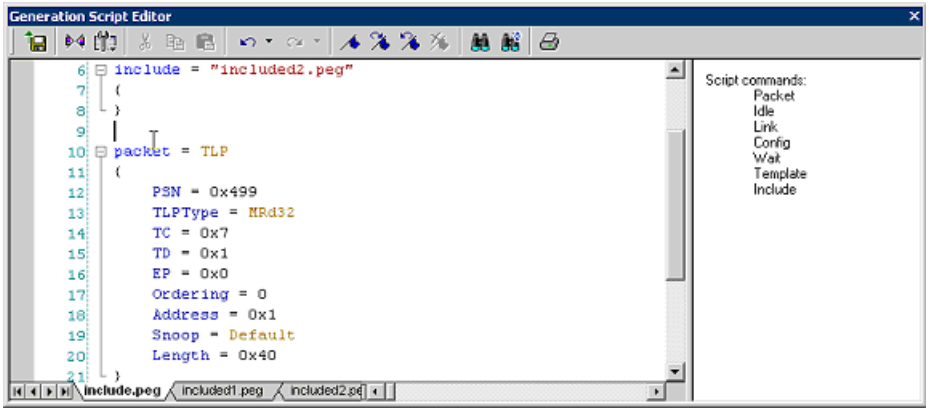


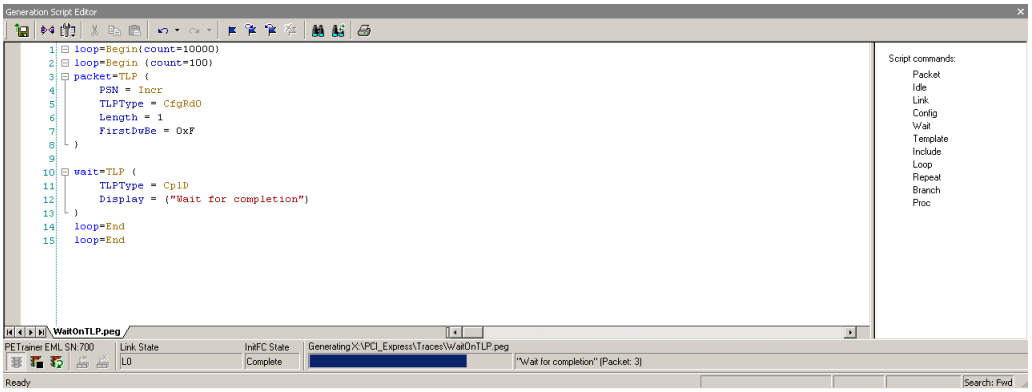
Command Properties Window

The Command Properties window lists all possible parameters for the current script command and all values for the parameters currently defined in this command. Entering parameters/values within the Edit window causes the Command Properties window to automatically update. Parameters/values can be changed by entering text into the text boxes or by selecting items from pull-down menus as shown in the example below.



In this case, the edit window is updated automatically. If the current script command does not have parameters or the current cursor position is outside of any script command, then a generic prompt is displayed in the window:





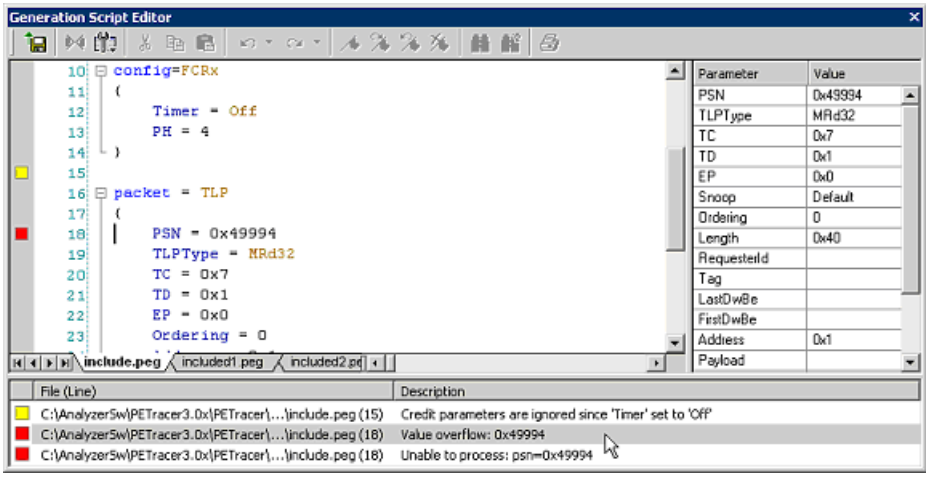
Script Editor File Tabs

At the bottom of the Script Editor window is the name of the open generation file.

If there are **Include** statements in the generation file that link it to other generation files, these files automatically open and display as tabs at the bottom of the window. You can click the tabs to toggle between the open generation files.

Script Editor Error Log

Whenever you create a scripting error, a log opens at the bottom of the application window. When the error is corrected, the window automatically closes.



Errors: Marked by red squares.

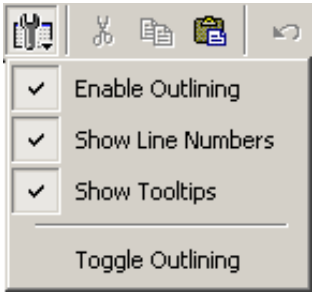
Warnings: Marked by yellow squares.

Double-clicking an error in the error log causes the cursor in the edit window to move to where the error was detected.

Note: You cannot run the script if it has syntax errors.

View Options Menu

The **View Options** button displays a menu with these options:



Enable Outlining: Adds an expandable/collapsible tree structure to the left side of the Script Editor showing the hierarchical relationships of the script lines.

Show Line Numbers: Adds line numbers to the left side of the Script Editor window.

Show Tooltips: Allows tooltip popups, which provide descriptions of script keywords when cursor mouses over a keyword.

Toggle Outlining: Toggles the outline tree between collapsed and expanded states.

10.4 Generation Options Dialogs Overview

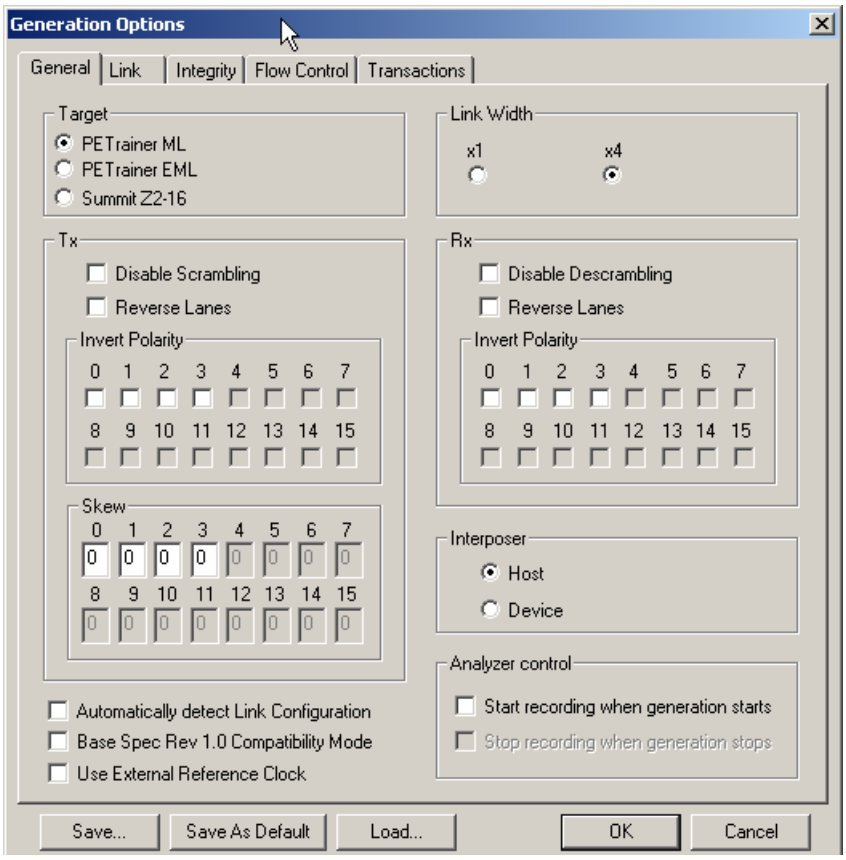
The Generation Options dialog box is used to set Config settings in a traffic generation script (for example, **Config = General** or **Config = Link**). This dialog duplicates the **Config** script command and is provided as a convenient alternative means of setting this command in the script.

Note: The Generation Options dialog is subordinate to the script itself, so script commands override options selected in this dialog box.

Opening the Dialog

To open the Generation Options dialog, select **Setup > Generation Options** or click the **Generation Options** button .

PE*Trainer* ML

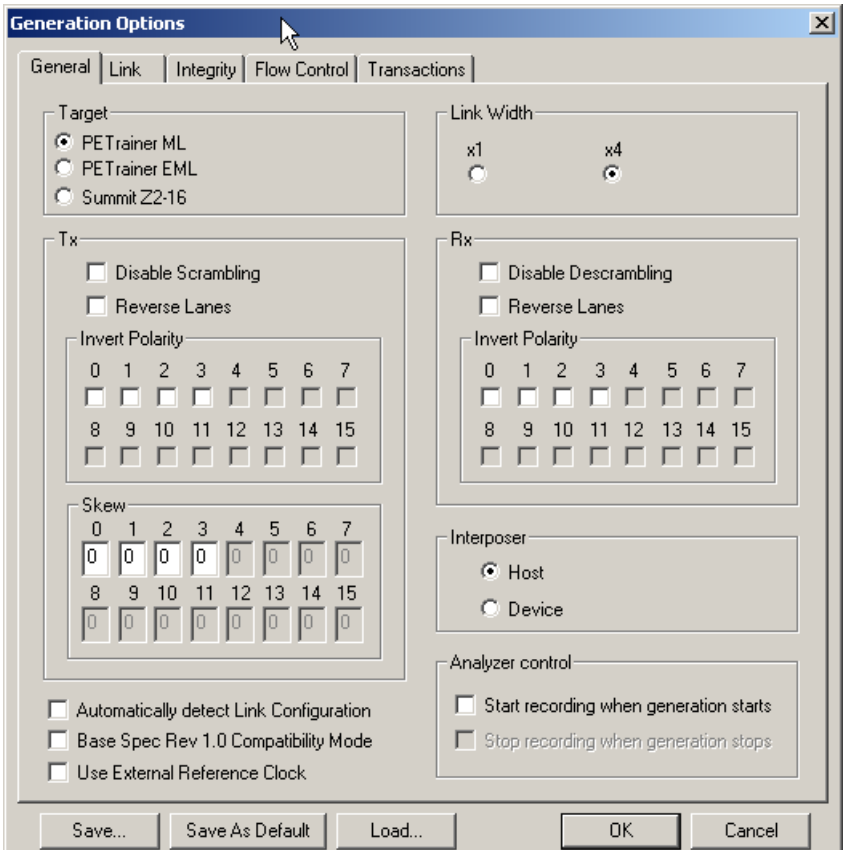


Dialog Layout

The Generation Options dialog is organized into five pages: General, Link, Integrity, Flow Control, and Transactions.

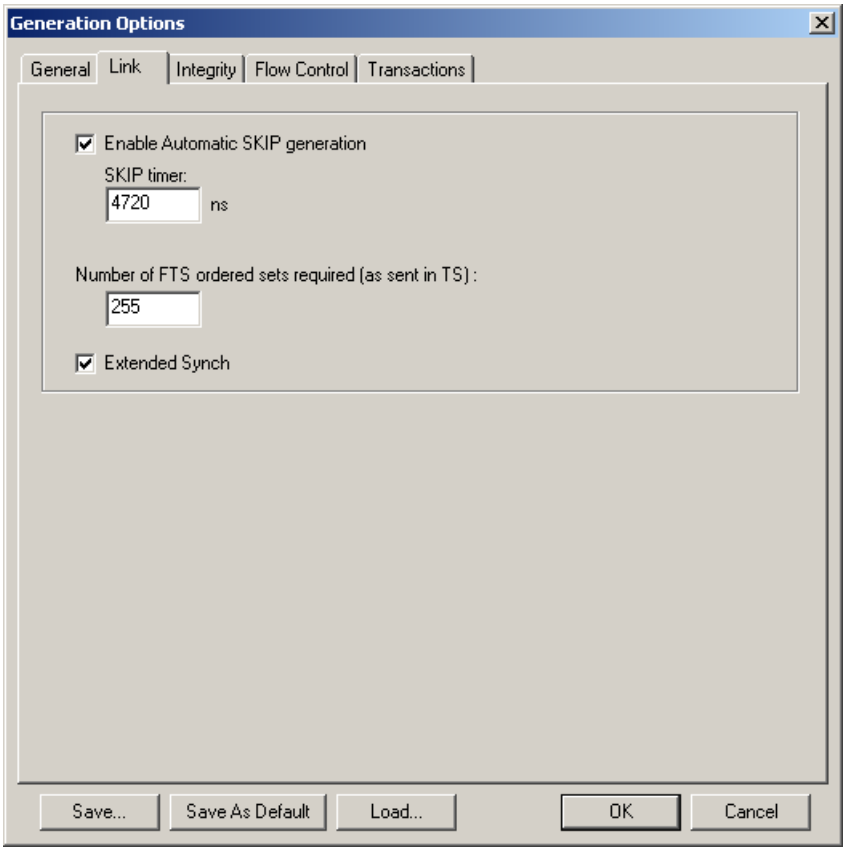
10.5 Generation Options for PE*Trainer* ML

General



Parameter	Values	Default	Comment
Target			Specifies the generation platform. The choice affects some of the options presented in the Generation Options dialog.
LinkWidth	1 2 4 8 16	1	Ignored if AutoDetect is set.
DisableScrambleTx	Yes No	No	Ignored if AutoDetect is set.
DisableDescrambleRx	Yes No	No	Ignored if AutoDetect is set.
ReverseLanesTx	Yes No	No	Ignored if AutoDetect is set.
ReverseLanesRx	Yes No	No	Ignored if AutoDetect is set.
InvertPolarityTx	(X,X,X,X)		Ignored if AutoDetect is set.
InvertPolarityRx	(X,X,X,X)		Ignored if AutoDetect is set.
SkewTx	(X,X,X,X)		
Interposer	Host Device	Host	Host = Host Emulation
BaseSpec10	Yes No	No	
UseExtRefClock	Yes No	Yes	Use external reference clock. (PE*Trainer* ML only)
AutoDetect	Yes No	Yes	Automatically detects Link Width (PE*Trainer* ML only), Polarity Inversion, Lane Reversal, and Scrambling.

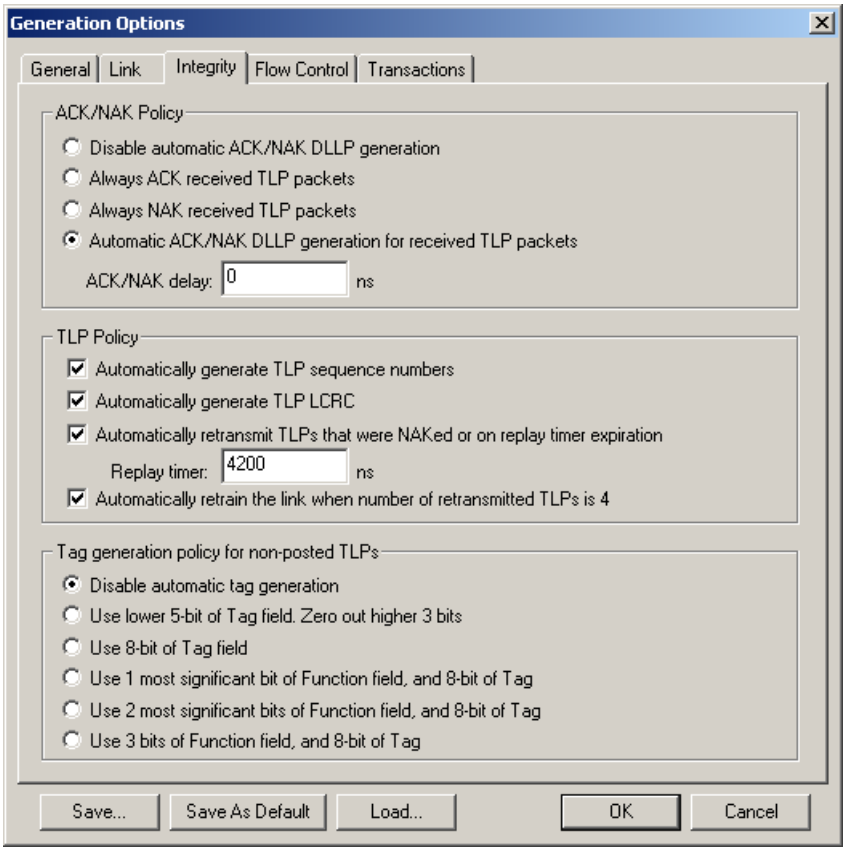
Link



Parameter	Values	Default	Comment
SkipTimer	In ns (rounded to nearest 8) Off	4720	Periodic timer that controls sending of SKIP ordered sets at specific intervals. Timer's value is measured in 1us units. The SKIP timer should be 4720 ns <-> 6152 ns per the spec.
FTSCount	0 to 255	255	Number of FTS ordered sets required (as sent in TS)
ExtendedSynch	Yes No	Yes	Forces LTSSM to send 4096 Fast Training Sequences when leaving LOs state. The value entered in the text box sets the NUM_FTS field in training patterns TS1, TS2 as generated by LTSSM.

Integrity

The Integrity page sets the parameters for two Config commands: **Config = TLP** and **Config = AckNak**

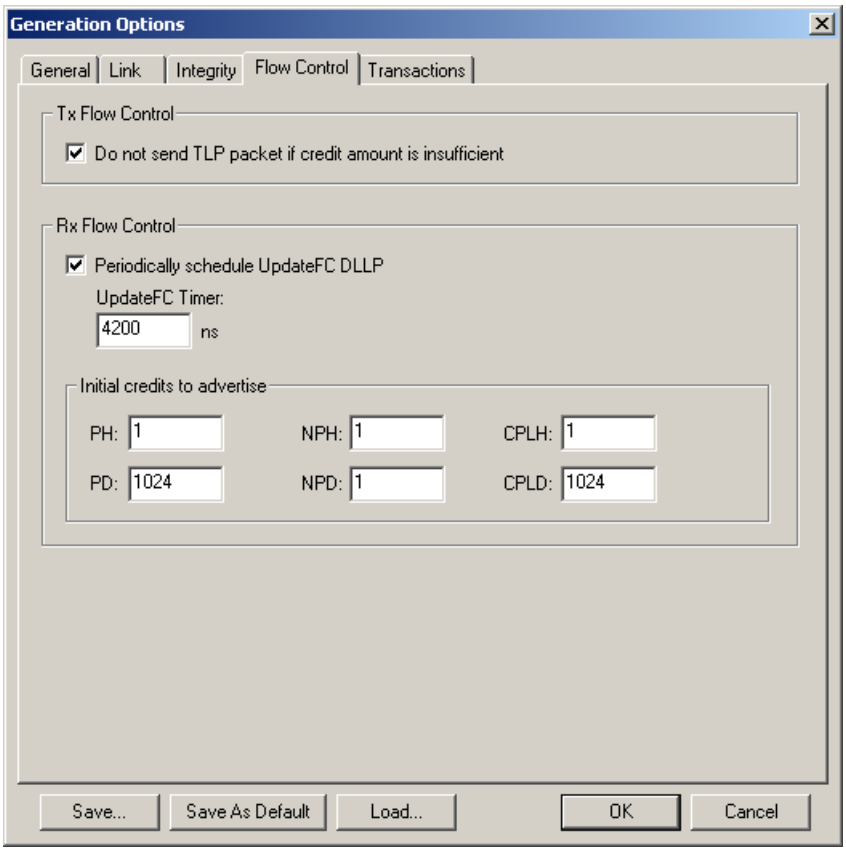

Generation Options
General
Link
Integrity
Flow Control
Transactions
ACK/NAK Policy
Disable automatic ACK/NAK DLLP generation
Always ACK received TLP packets
Always NAK received TLP packets
Automatic ACK/NAK DLLP generation for received TLP packets
ACK/NAK delay: 0 ns
TLP Policy
Automatically generate TLP sequence numbers
Automatically generate TLP LCRC
Automatically retransmit TLPs that were NAKed or on replay timer expiration
Replay timer: 4200 ns
Automatically retrain the link when number of retransmitted TLPs is 4
Tag generation policy for non-posted TLPs
Disable automatic tag generation
Use lower 5-bit of Tag field. Zero out higher 3 bits
Use 8-bit of Tag field
Use 1 most significant bit of Function field, and 8-bit of Tag
Use 2 most significant bits of Function field, and 8-bit of Tag
Use 3 bits of Function field, and 8-bit of Tag
Save...
Save As Default
Load...
OK
Cancel

Parameter	Values	Default	Comment
AckNak Policy	Auto Ack Nak Disable	Auto	**Auto**: Automatic ACK/NAK DLLP generation for received TLP packets (default). **Ack**: Always ACK received TLP packets **Nak**: Always NAK received TLP packets **Disable**: Disable automatic ACK/NAK DLLP generation.
AckNak Policy AckNak Delay	In ns (rounded to nearest 8)	0	Timer that controls how much delay is added to AckNak DLLP response after TLP reception. Valid if AckNak is Auto, Ack, or Nak. Used to delay AckNak, thereby allowing customers to test their replay mechanisms and replay timer.
TLP Policy AutoSeqNumber	Yes No	Yes	If not set, overrides automatic generation of the TLP sequence number and uses user-defined value of the field in the **Packet=TLP** commands. This option overrides any sequence numbers specified in the script.
TLP Policy AutoGenerate LCRC	Yes No	Yes	If not set, overrides automatic generation of LCRC and uses user-defined value of the field in the **Packet=TLP** commands. This option overrides any LCRC specified in the script.
TLP Policy ReplayTimer	In ns (rounded to nearest 8) Off	4200	Timeout in TLP transmitter path that counts time since last Ack or Nak DLLP is received. If set, automatically retransmit TLPs that were NAKed or on replay timer expiration.
TLP Policy AutoRetrain	Yes No	Yes	If set, enable automatic retraining of the link in case the number of retransmitted TLP is 4. Valid only when AutoRetransmission is set.

Automatic Tag Generation	Yes No	No	Disable automatic tag generation. Prevents PE*Trainer* from automatically inserting a tag. Tags are a sub-field of the transaction ID field. When auto tag insertion is enabled, the tag field is only modified for non-posted transactions such as **CfgRd, CfgWr**, and **MemRd**. Options are: Use lower 5-bit of Tag field. Zero out higher 3 bits. Use 8-bit of Tag field. Use 1 most significant bit of Function field and use 8-bit of Tag field. Use 2 most significant bits of Function field and use 8-bit of Tag field. Use 3 bits of Function field and use 8-bit of Tag field.

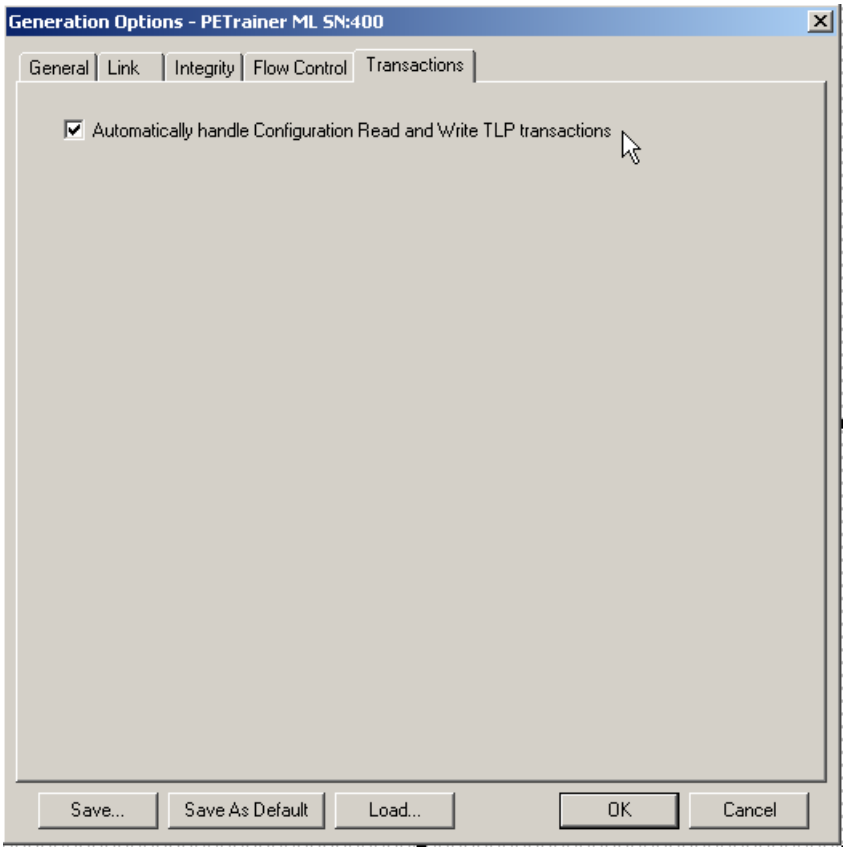
Flow Control

The Flow Control page sets parameters for **Config = FCTx** and **Config = FCRx**.



FCRx Parameter	Values	Default	Comment
Enable Tx Flow Control	Yes No	Yes	When not set, the TLPs are being sent without the regard of how many credits are available. This option prevents TLP transmission if insufficient credits are available.
Enable Rx Flow Control	In ns (rounded to nearest 8) Off	4200	When enabled, allows automatic updating of these DLLPs. This option enables a periodic timer that controls sending of UpdateFC DLLPs. You should leave timer and credit values to defaults for correct behavior.
PH	0 to 255	1	Posted Request Headers
NPH	0 to 255	1	Non-Posted Request Headers
CplH	0 to 255	1	Completion Headers
PD	0 to 4095	1024	Posted Request Data Payload
NPD	0 to 4095	1	Non-Posted Request Data Payload
CplD	0 to 4095	1024	Completion Data Payload

Transactions



Parameter	Values	Default	Comment
Automatically handle Configuration Read and Write TLP transactions	Yes No	No	If set, automatically handles Configuration Read and Write TLP transactions. For Configuration Read transaction, Completion TLP contains the data read from the internal Configuration Space according to specified register address. For Configuration Write transaction, internal Configuration Space is updated at the address with the data taken from Configuration Write TLP, and Configuration Write Completion is returned. This option enables Read and Write access to 4 KB configuration space.

10.6 Generating Traffic: Set Generation Options

Before beginning generation, set options in the Generation Options dialog box:

Step 1 Open the Generation Options dialog box by selecting **Setup** > **Generation Options** from the menu. The Generation Options dialog opens.

By default the General page displays.

Step 2 To test 1.0 devices, check the box next to **Base Spec Rev. 1.0 Compatibility Mode** to select 1.0 compatibility mode.

To test 1.0A devices, leave this box unchecked.

Step 3 Set the generation direction based on type of device you are emulating.

Step 4 Select one of the two **Interposer** options:

- **Host Emulation**: Select **Host**
- **Device Emulation**: Select **Device**

Step 5 Select the **Link** tab. The Link page opens.

Step 6 Select **Enable Automatic Skip Generation,** but leave the setting at the default value: 4720 ns.

Step 7 Select the **Integrity** tab**.** The Integrity page opens.

Step 8 Check to enable **Automatic ACK/NAK DLLP generation for received TLP packets**.

Step 9 Enable all four TLP policies.

Step 10 Select the **Flow Control** tab. The Flow Control page opens**.**

Step 11 Check the checkbox to enable **Do not send TLP packet if credit amount is insufficient.**

Step 12 Check the checkbox to enable **Periodically schedule UpdateFC DLLP**.

Step 13 Use the defaults for all other boxes.

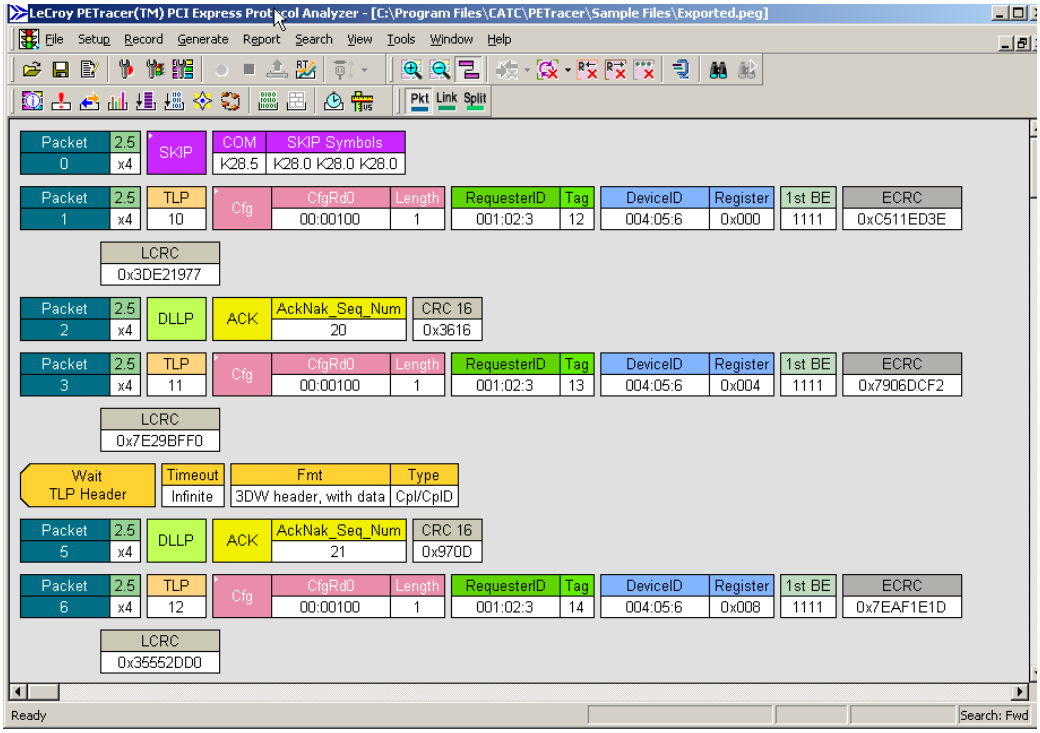
Step 14 Click **OK** to apply all changes and close the Generation Options dialog.

10.7 Generating Traffic: Prepare Traffic Generation

To prepare for traffic generation, follow these steps:

Step 1 If it is not running, start the PE*Tracer*™ software.

Step 2 Open an existing script file or create a new script. For example, open the traffic generation file **Linkup.peg** by selecting **File** > **Open** from the menu. The following packets display in the main window.


LeCroy PETracer(TM) PCI Express Protocol Analyzer - [C:\Program Files\CATC\PETracer\Sample Files\Exported.peg]
File Setup Record Generate Report Search View Tools Window Help
Pkt Link Split
Packet 0 2.5 x4 SKIP COM K28.5 SKIP Symbols K28.0 K28.0 K28.0
Packet 1 2.5 x4 TLP 10 Cfg CfgRd0 00:00100 Length 1 RequesterID 001:02:3 Tag 12 DeviceID 004:05:6 Register 0x000 1st BE 1111 ECRC 0xC511ED3E
LCRC 0x3DE21977
Packet 2 2.5 x4 DLLP ACK AckNak_Seq_Num 20 CRC 16 0x3616
Packet 3 2.5 x4 TLP 11 Cfg CfgRd0 00:00100 Length 1 RequesterID 001:02:3 Tag 13 DeviceID 004:05:6 Register 0x004 1st BE 1111 ECRC 0x7906DCF2
LCRC 0x7E29BFF0
Wait TLP Header Timeout Infinite Fmt 3DW header, with data Type Cpl/CplD
Packet 5 2.5 x4 DLLP ACK AckNak_Seq_Num 21 CRC 16 0x970D
Packet 6 2.5 x4 TLP 12 Cfg CfgRd0 00:00100 Length 1 RequesterID 001:02:3 Tag 14 DeviceID 004:05:6 Register 0x008 1st BE 1111 ECRC 0x7EAF1E1D
LCRC 0x35552DD0
Ready
Search: Fwd

The CATC Trace window shows the type of traffic that is to be generated in the current generation session.

Step 3 If needed, make changes to the script file,

then save the file by clicking the **Save** button .

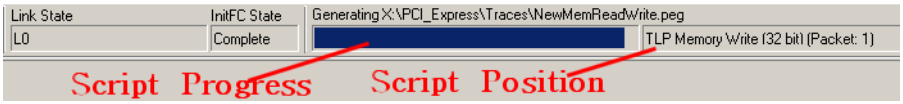
10.8 Generating Traffic: Begin Traffic Generation

To begin traffic generation:

Step 1 Start generation by clicking the **Start Traffic Generation** button on the Status bar.

This action causes the software to download the script to the PE*Trainer* device. After the download completes, the device starts executing the script.

As the script executes, the Status bar displays the script's progress. The **Current script position** field displays the command description and CATC Trace packet number currently being generated.

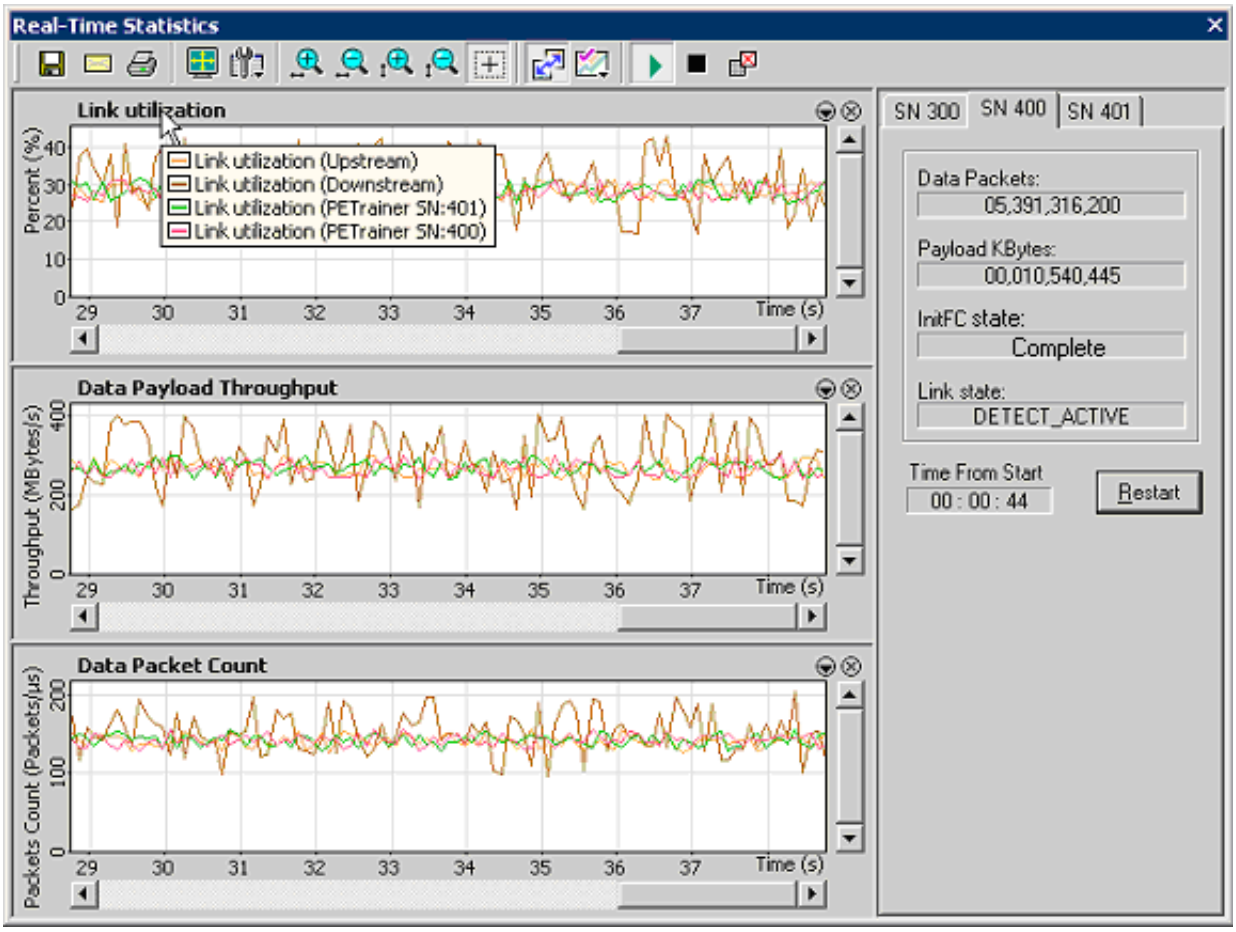


Note: Script execution can be terminated at any time by clicking the **Stop Generation** button on the toolbar.

If a Wait command is executed where the Display parameter is specified, the user-defined text is displayed.

If a **wait=user** script command is executed, the script pauses until you click the **Resume Generation** button on the toolbar.

Step 2 Open the Real-Time Statistics window by clicking .



To the right is a **Statistics Accumulation** area. In this area look for two messages:

- **InitFC State:** Complete (shown in the example above)
- **Link State**: LO

If the messages appear, then it means that the Exerciser successfully completed the Link training.

Note: Link training can also be performed by clicking the **Trainer Connect** button on the Status bar.

Chapter 11: Macros

11.1 Macros

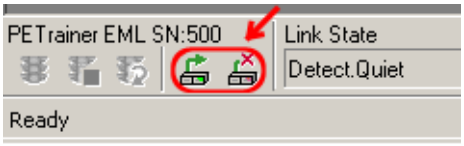
PE*Trainer*™ ML allows you to add buttons to the Status bar at the bottom of the window (and add commands to the Generate menu) to run traffic generation macros on the Exerciser.

After a macro script has been defined and assigned to a button the on the Status bar, the macro can be run by clicking the macro button with the mouse or selecting the macro name from the Generate menu.

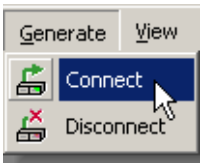
Default Macros: Connect and Disconnect

By default, the PE*Tracer*™ software includes two macros, **Connect** and **Disconnect**. These buttons execute macros for creating and breaking a connection between the Exerciser and a DUT.

The buttons are on the Status bar when Exerciser hardware is present.



The commands are also on the Generate menu:



Connect Macro

The default code for this macro is the following:

```
Config = General {TrainerReset = 1}
Link = Detect
Wait = 500
Link = L0
Wait = 500
Link = InitFC
```

Disconnect Macro

The default code for this macro is the following:

```
Config = General {TrainerReset = 1}
Link = Detect
```

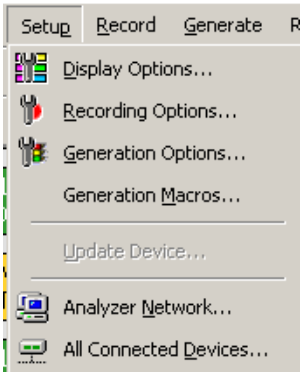
11.2 Adding New Script Macros

There are two ways to add script macros:

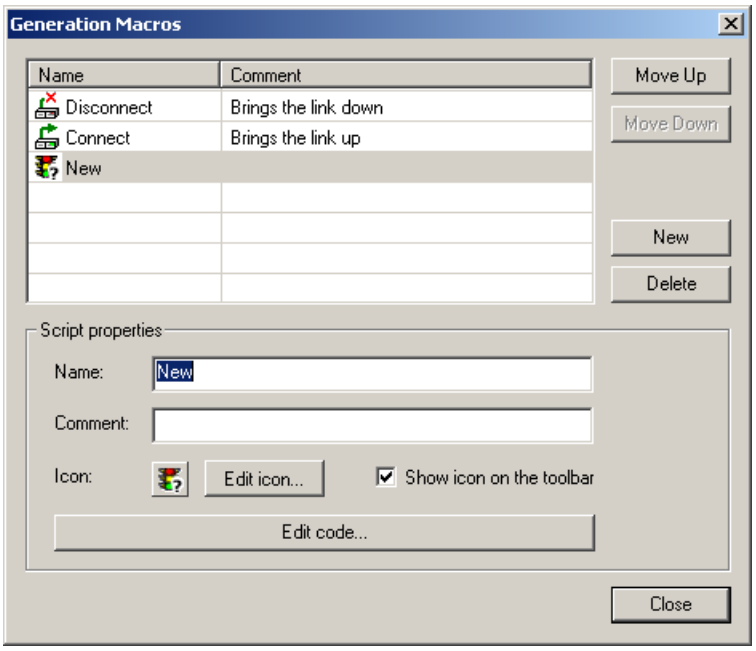
- Using the Generation Macros dialog
- Adding script files to the GenScriptMacros directory.

Using the Generation Macros Dialog

Step 1 Open the Generation Macros dialog by selecting **Setup > Generation Macros** from the menu.

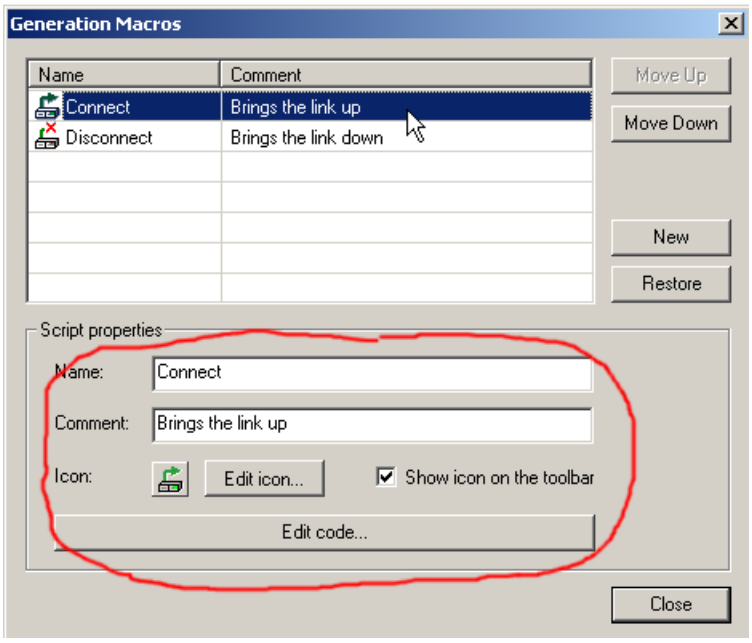


Step 2 In the Generation Macros dialog box, click the **New** button.



Step 3 Within **Script properties** area specify **script name, script comment, script icon,** and **whether or not to show script icon** on a toolbar.

Step 4 Create a new icon for the script by clicking **Edit Icon**... button. The Edit Generation Macro Icon dialog appears.



Step 5 Using the tools provided, paint the icon for new script macro and then press **OK**.

Step 6 Edit the script code by clicking the **Edit code**... button. The dialog closes and an empty script editing window appears (see Section 10.3, “Editing Generation Files with the Script Editor” on page 210).

Step 7 Type the script code and press the **Save** button. The script macro and icon are saved in the **GenScriptMacros** directory located under the PE*Tracer* directory (for example, **Program Files\CATC\PETracer\GenScriptMacros**).

Step 8 Close the script window. The new macro script button automatically appears on the Status bar at the bottom of the window. Clicking this button causes PE*Trainer* to execute the script.

Adding Script Files to the GenScriptMacros Directory

The second way to add a new PE*Trainer* script macro is to copy an existing PE*Trainer* script file in the **GenScriptMacros** directory.

Step 1 Copy a script file into the **GenScriptsMacros** directory located under the PE*Tracer* directory (for example, **Program Files\CATC\PETracer\GenScriptMacros**).

Step 2 Switch to the PE*Tracer* application. You see that a new icon has been automatically added for the script file to the Status bar at the bottom of the window. The default icon is assigned to the new script macro and the file name is used as a script name.

11.3 Modifying Script Macros

To modify a macro assigned to a button:

Step 1 Select **Setup > Generation Macro** from the menu.

The Generation Macros dialog opens for modifying, creating, and deleting macros:

Name: Name of Macro

Comment: Descriptive comment so you can remember what the macro does

Icon: Currently assigned button for the macro.

Show icon on the toolbar: If checked, places the icon on the Status bar.

Edit Code: Opens a dialog for editing the macro script.

Step 2 Select the macro to be modified.

Step 3 Within the **Script properties** area, modify the **script name, script comment, script icon,** and whether or not to show script icon

Step 4 To edit script code, press the **Edit code**... button. The Generation Macros dialog closes and the Script Editing window appears, showing current code for the selected script macro.

Note: If the Generation Script Editor pane does not appear, click .

Step 5 Modify the script code and press the **Save** button .

Step 6 Close the script window. The macro has now been modified.

11.4 Changing the Order of Macro Icons on the Status Bar

To change the order of script macro icons on the Status bar:

Step 1 Open Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Click the **Up** and **Down** buttons to change the order of the script macros.

Step 3 Close the dialog. The button order is changed.

11.5 Deleting User-Defined Script Macros

To delete a script macro:

Step 1 Open the Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Select the macro you want to delete and press the **Delete** button:

All deleted scripts and icons are removed from **GenScriptMacros** directory. A backup copy is stored in the **GenScriptMacros\Deleted** directory.

Note: You cannot delete the Connect and Disconnect script macros.

11.6 Restoring the Default Appearance of the Connect and Disconnect Icons

You can restore the default appearance of the Connect and Disconnect icons by clicking the **Restore** button.

Step 1 Open the Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Select the macro you want to restore and press the **Restore** button.

Chapter 12: Address Space

12.1 Address Space Toolbar Buttons and Dialogs

On the PE*Trainer*™ toolbar at the bottom of the application window are two buttons:

- Write Address Space
- Read Address Space

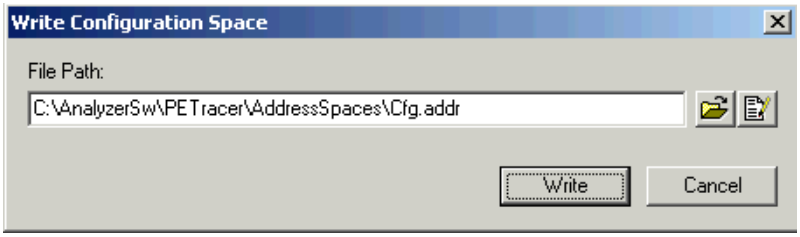
Clicking these buttons opens a dialog for selecting, creating, or editing Address Space settings used by PE*Trainer*. The dialog can also be accessed from the menu: **Generate > Write Address Space** and **Generate > Read Address Space**.

Write Address Space Button

The Write Address Space button brings up a dialog.

Write Address Space Dialog for PE*Trainer* ML

PE*Trainer* ML supports only the Configuration Address Space.



You can open a browse dialog for selecting a configuration space file.

You can open the Configuration Space Editor for editing or creating configuration space files.

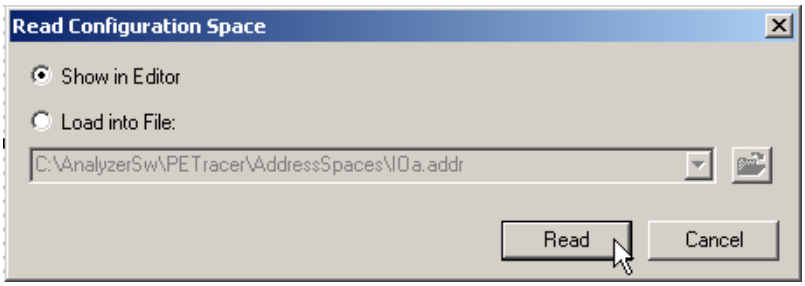
Note: The Configuration Address Space cannot be written to PE*Trainer* ML when a generation script is running.

Read Address Space Button

This Read Address Space button brings up a dialog.

PE*Trainer* ML Read Address Space Dialog

PE*Trainer* ML supports only Configuration Address Space.

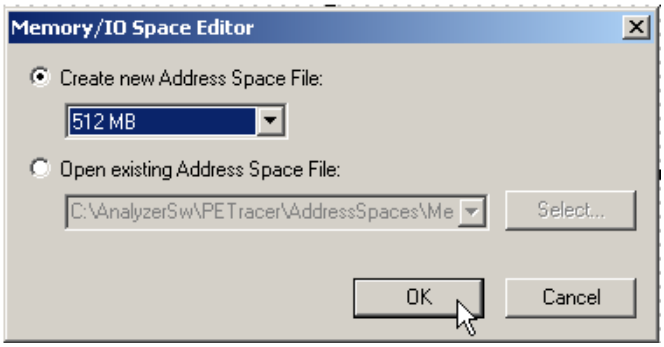


Note: The Configuration Address Space cannot be read from PE*Trainer* ML when a generation script is running.

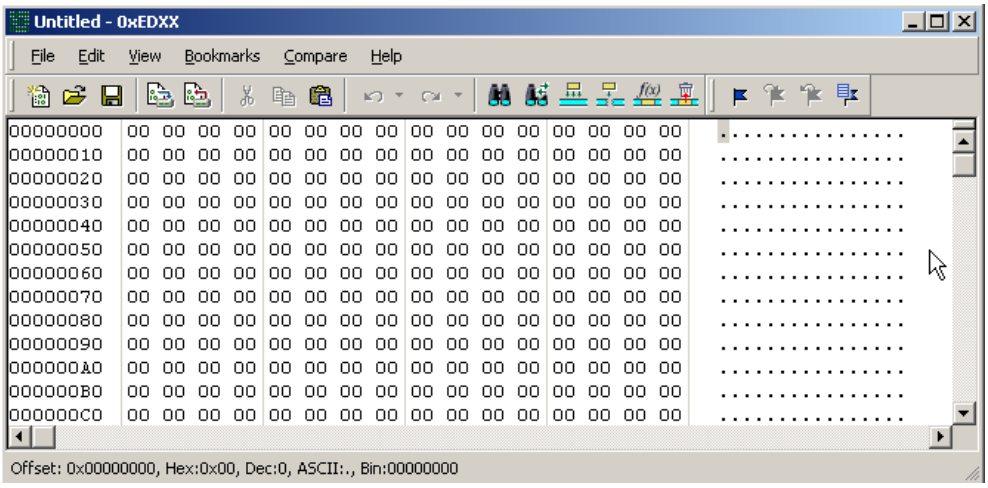
12.2 Memory/IO Space Editor

The Memory/IO Space Editor lets users write address space memory into PE*Trainer*™ and read address space memory from PE*Trainer*.

To access the Memory/IO Space Editor, select **Tools > Memory/IO Space Editor**. The following dialog opens:



- **Create new Address Space File**: Opens the Memory/IO Space Editor and displays an empty address space with the size specified.
- **Open existing Address Space File**: Activates the list of recently used Memory/IO Address Space files and enables the Select... button. After you have selected a file and then clicked **Select,** the Memory/IO Space Editor opens.



The Memory/IO Address Space editor is implemented as a standard hex editor.

The address space memory must be saved to a file so that it can be downloaded to the PE*Trainer* hardware using PE*Tracer*™ application.

If you prefer, you can write address space memory into PE*Trainer* and read address space memory from PE*Trainer* directly using the

and toolbar buttons or using the menu **File > Write Address Space** or **File > Read Address Space**.

Chapter 13: Configuration Space

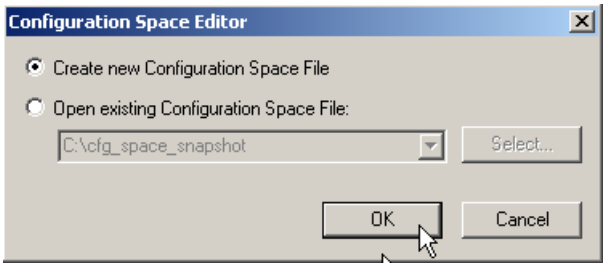
13.1 Configuration Space Editor

The Configuration Space Editor allows the Configuration Space to be modified on a field-by-field basis using hexadecimal or binary format.

The editor supports PCI-compatible Configuration Spaces and PCI Express enhanced Configuration Spaces.

13.2 Launching the Configuration Space Editor

Selecting **Tools > Configuration Space Editor** displays the following dialog:



- **Create new Configuration Space File**: Opens the Configuration Space Editor with the default (empty) configuration space.
- **Open existing Configuration Space File**: Activates the list of recently used configuration space files and enables the **Select.**.. button. After you select a file and click **OK,** the Configuration Space Editor opens.

Configuration Space Files

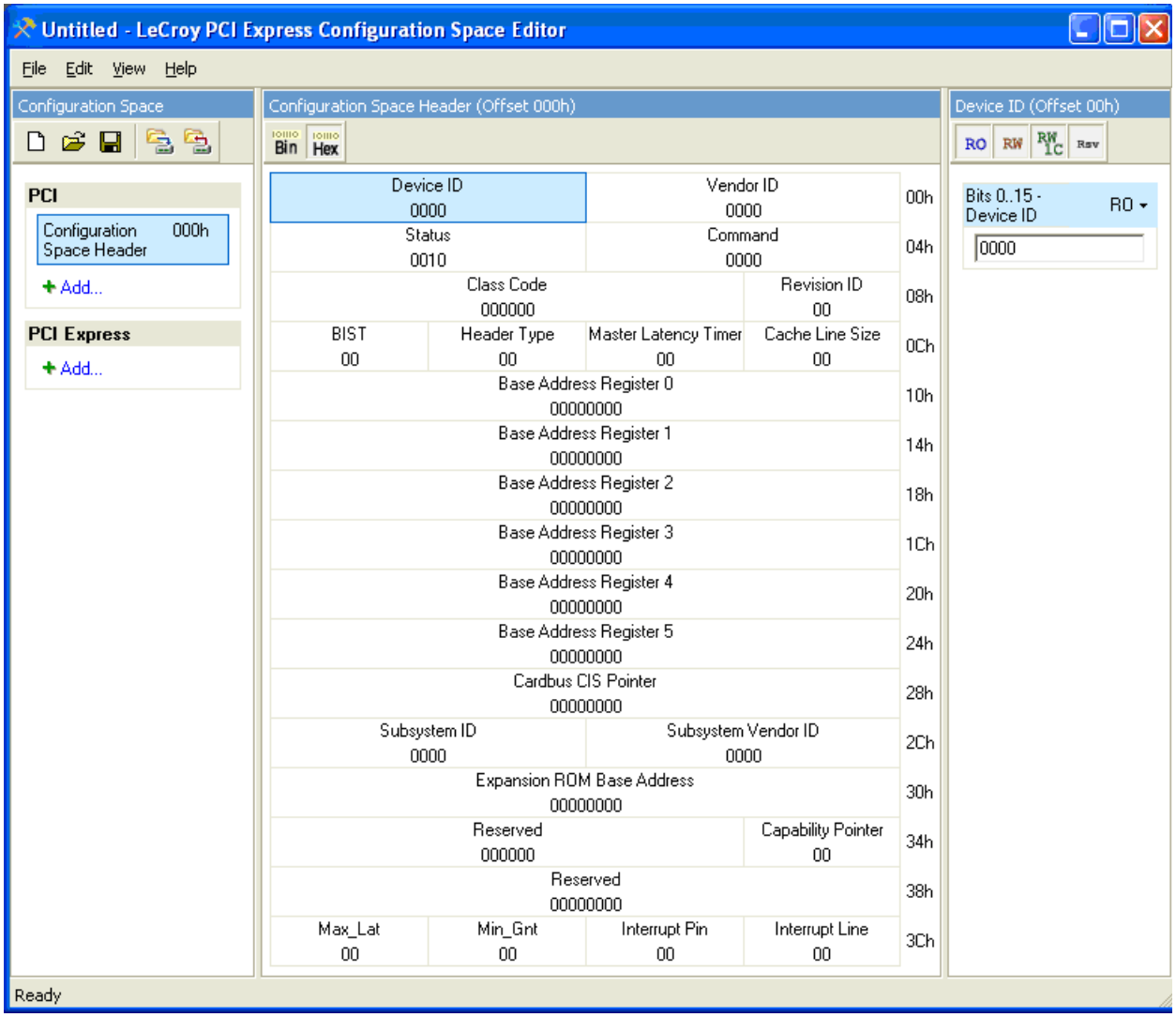
You can save configuration space files in the Configuration Space View (see “Configuration Space View” on page 179). Open a trace file, select a packet, and then select **Reports > Configuration Space View**. Click the **Save** button to display the Save As dialog and enter a file name (which has no special file extension).

You can save configuration space files in the Configuration Space Editor. Click the **Save** button to display the Save As dialog and enter a file name (which has no special file extension).

You can open saved configuration space files in the Configuration Space Editor and optionally edit them. You can then use them for generation.

Editing

When a new file is created, a blank **PCI Configuration Space Header** is loaded for editing. However, its position is not configurable, and the offset always starts at 000h.



In the Configuration Space View, at the left, you can add and define PCI-compatible or PCI Express Configuration-Space Capability Structures.

The toolbar allows you to create a New configuration space, Open a configuration-space file, Save a file, Write Configuration Space, and Read Configuration Space.

Click **+ Add** and then choose a Capability Structure from the context menu. You can also select **Edit > Add PCI Capability** or **Edit > Add PCI Express Capability.**

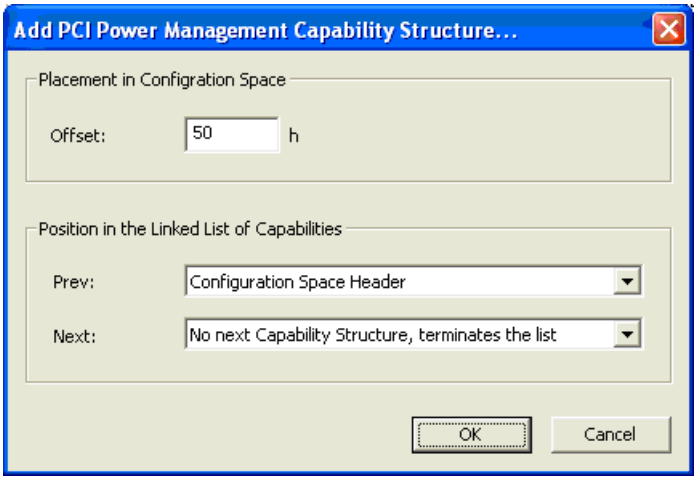
Available PCI Capability Structures are:

- Message Signaled Interrupts
- Accelerated Graphics Port
- Vital Product Data
- Vendor-Specific
- PCI Express
- Hyper Transport
- Generic

Available PCI Express Capability Structures are:

- Virtual Channel
- Virtual Channel for MFVC
- Device Serial Number
- Power Budgeting
- Root Complex Link Declaration
- Root Complex Internal Link Control
- Root Complex Event Collector Endpoint Association
- Vendor-Specific
- RCRB
- ACS
- MFVC
- Resizable Bar
- Multicast
- DPA
- ARI
- LTR
- SR IOV
- Generic

Selecting a structure displays a dialog in which you can define the structure.

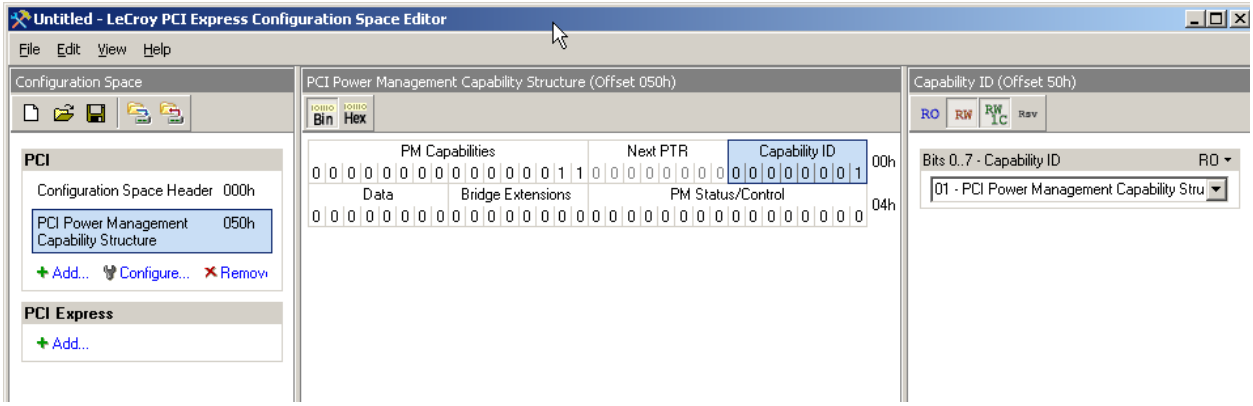


Enter an integer **Offset**.

Position the structure in the linked list of capabilities by selecting the **Previous** and **Next** capability structures.

Note: The Configuration Space View, from the Reports menu, reflects any added structures (see “Configuration Space View” on page 179).

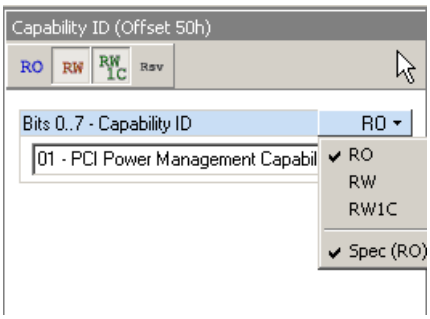
After you click **OK**, the center column displays the Capability Structure View, with the register layout. You can modify the selected Capability Structure by selecting registers and editing in binary or hex. The toolbar allows you to select Binary or Hexadecimal for editing.



Alternatively, after selecting a register, you can modify the register in the Field View in the right column.

The Field View allows you to override field attributes. By default, attributes are assigned according to the specification. The available options are:

- **RO**: Read Only
- **RW**: Read-Write
- **RW1C**: Write-1-to-Clear

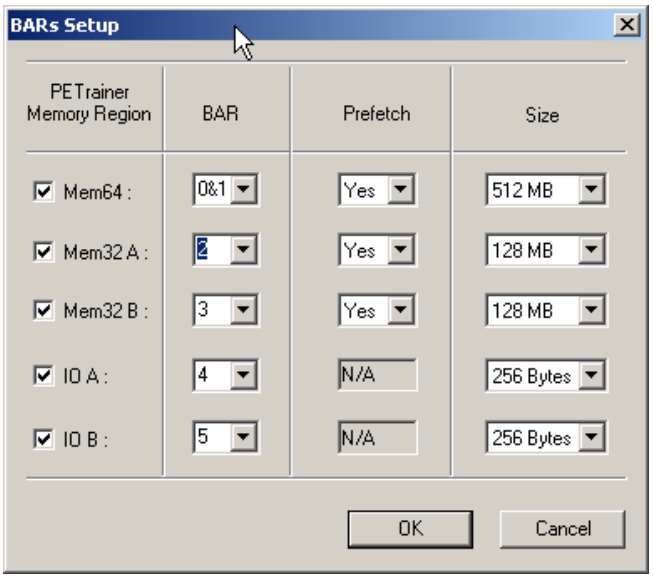


Note: See Appendix A “Configuration Space Decoding” on page 249.

13.3 BARs Setup

The BARs Setup dialog helps set up Base Address Registers. It provides a more convenient way of defining BARs than setting up the BARs manually. In addition, it provides the mapping of BARs to PE*Trainer* and Summit Z2-16 memory regions.

To open the BARs Setup, select **Edit > BARs Setup**.



BAR1 and BAR2 are assigned to 64-bit memory address space and mapped to Mem64 PE*Trainer* memory region. BAR4 is assigned to 32-bit memory address space and mapped to Mem32A PE*Trainer* memory region.

You can specify Prefetch and Address Space Size. The sizes for each address space are limited to the values supported by PE*Trainer* hardware.

BAR and Prefetch fields affect the Hexadecimal/Binary in the middle column of the Configuration Space Editor.

Size field affects Field View in the right column of the Configuration Space Editor.

The mapping of BARs to PE*Trainer* memory regions is discussed at the AddressSpace Command in the Help section of the PE*Trainer* Script Language.

The BAR settings are used for Memory and IO completer.

13.4 Configuration Read and Write

PE*Trainer*™ can automatically handle Configuration Read and Write TLP transactions:

- For a Configuration Read transaction, the Completion TLP contains the data read from the internal Configuration Space according to specified register address.
- For a Configuration Write transaction, the address for the internal Configuration Space is updated with the data taken from Configuration Write TLP, and Configuration Write Completion is returned.

You can specify the initial Configuration Space by editing the **AddressSpace=Write** command directly in the script or by using the UI provided in the Generator toolbar.

The PE*Tracer*™ software provides a special editor for editing this file called the Configuration Space Editor (see “Launching the Configuration Space Editor” on page 241).

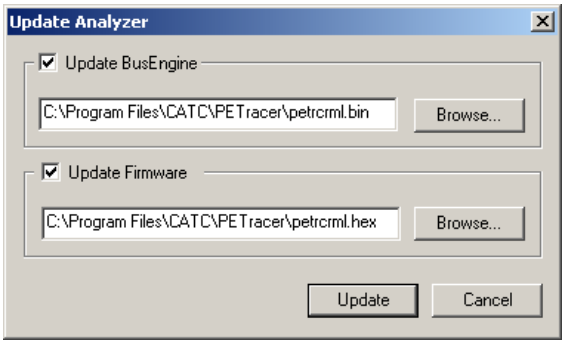
Chapter 14: Updates and Licensing

14.1 Updating the Analyzer

BusEngine™ and/or Firmware updates are now automatic processes that run anytime a new version of the PE*Tracer*™ software is installed that is incompatible with the currently installed BusEngine or Firmware. The update process generates onscreen instructions.

If, however, you need to manually perform BusEngine or Firmware updates, follow these steps:

Step 1 Select **Setup > Update Device** … from the menu to display the Update Analyzer dialog box for **PE*Tracer* ML™**:



Step 2 Select the appropriate file locations for the Firmware and/or BusEngine, using Browse, if necessary.

Step 3 Check the appropriate options (if in doubt, check all options).

Step 4 Click **Update** to initiate the updating of the Analyzer.

Updating the Exerciser

To manually update the BusEngine and/or Firmware for PE*Trainer* ML, follow the same steps as above.

14.2 License Keys

A License Key is necessary to enable software maintenance. If you attempt to record with the Analyzer without an installed License Key, a message appears to indicate that a License Key is necessary in order to record traffic.

A License Key must be obtained from Teledyne LeCroy for each Analyzer.

After you obtain the License Key, follow these steps to install it:

Step 1 Select **Help > Update License**… from the menu bar. to display the Update License dialog box.

Step 2 Enter the **path** and **filename** for the License Key or use the Browse button to navigate to the directory that contains the License Key.

Step 3 Select the **.lic** file, and then click **Update Device**.

You can also update your licensing information by selecting **Setup > All Connected Devices** …, then clicking **Update License**.

14.3 License Information

You can view Licensing information for your Analyzer by selecting **Help > Display License Information**... from the menu bar. The License Information window displays data about the maintenance expiration and purchased features.

Appendix A: Configuration Space Decoding

The decoded capability structures in the Configuration Space Viewer and Editor are based on programmed definitions in the PE*Tracer* software and on Configuration Space Decode Scripts.

Configuration Space Decode Scripts are tools to define capability structures and instruct the Configuration Space Viewer or Editor how to decode them. These scripts are in the **\CfgSpaceScripts** sub-directory below the **\Scripts** directory in the application directory.

You can write Configuration Space Decode Scripts using the CATC Scripting Language (CSL). See the *Teledyne LeCroy Analyzers File Based Decoding Manual* for reference.

PCI Express Configuration Space Decode Scripts have the file extension **.pecfgdec**.

A.1 Mandatory Definitions

Configuration Space Decode Scripts must set the following reserved variables.

- **CapabilityName**: Name of the capability structure
- **CapabilityID**: ID of the capability structure
- **ExtAddSpace**: Set to 1 if Extended Configuration Space.
  Otherwise, set to 0 for PCI.

A.2 Mandatory Module Functions

Modules are collections of functions and data dedicated to decoding a specific capability structure. Each module has one primary Configuration Space Decode Script file (extension **.pecfgdec**) and optionally has include files (**.inc**).

A module function is an entry-point into a decoding module. To help display a capability structure, the application calls a module function.

The Configuration Space Editor and Viewer support only the **DecodeRegister(offset)** and **GetSize( )** functions.

DecodeRegister(offset)

The application calls this function while decoding a specific DWORD offset of the specified CapabilityID. The offset is the decoding entry point, where the decoding path starts.

The Configuration Space Editor calls this function to determine how to decode the assigned configuration space. The **offset** parameter is the DWORD to decode.
An offset of 0 indicates bytes 00h-03h, an offset of 1 indicates bytes 04h-07h, and so on.

Note: The Configuration Space Editor can only decode one DWORD at a time.

GetSize()

This function returns the size of the capability structure specified by CapabilityID.

A.3 Configuration Register Types

The following reserved variables are defined global constants.

- CFGREG_UNDEFINED
- CFGREG_HWINIT
- CFGREG_RO
- CFGREG_RW
- CFGREG_RW1C
- CFGREG_ROS
- CFGREG_RWS
- CFGREG_RW1CS
- CFGREG_RSVDP
- CFGREG_RSVDZ

Note: These reserved variables match the Configuration Register Types of Table 7-2 in Section 7.4 of the PCI Express Base Specification, Rev. 2.1.

A.4 Primitives

Decoding uses the following primitives.

GetRegisterField(dword_offset, bit_offset, field_length)

This function returns a register field of length **field_length**, starting at bit position **bit_offset** in DWORD **dword_offset**.

- **dword_offset**: DWORD offset of the register field location
- **bit_offset**: Bit offset of the register field location
- **field_length**: Length of the register field

For example, **GetRegisterField(1, 9, 2);** means: Go to DWORD 1, bit offset 9, and returns 2 bits.

AddField(field_name, field_length, configuration_reg_type, tooltip, encoding_table = NULL)

This function adds a register field to the Capability View and returns a pointer to the field, for adding subfields.

- **field_name**: Name of the register field to display in the Capability View
- **field_length**: Length of the register field
- **configuration_reg_type**: Configuration register type of the register field. Note: If subfields are defined, their configuration register types override this setting for their specified bits.
- **tooltip**: Tooltip displayed for the register field in the Capability View
- **encoding_table**: Optional. Displays encodings as lists for select values.
- For example, user input becomes a combo box for the field in the Field View.

As examples:
AddField("PCI Express Extended Capability ID", 16, CFGREG_RO, "");
means: Add the field "PCI Express Extended Capability ID" with length 16 and cfg register type CFGREG_RO.

capability_reg = AddField("Capability Register", 32, CFGREG_RW, "");
means: Added the field "Capability Register" with length 32 and cfg register type CFGREG_RW and stored a pointer to this field in variable capability_reg, which can be used to add subfields to this field.

AddSubField(parent_field, subfield_name, subfield_length, configuration_reg_type, tooltip, encoding_table = NULL);

This function adds a subfield to a register field in the Capability View. Subfields are modifiable and visible in the Field View and appear in the tooltips of register fields.

- **parent_field**: Pointer to a register field in the Capability View
- **subfield_name**: Name of the subfield, displayed in the Field View
- **subfield_length**: Length of the subfield
- **configuration_reg_type**: Configuration register type of the subfield field. Note: This overrides the configuration_reg_type of the parent field.
- **tooltip**: Tooltip displayed for the subfield in the Capability View
- **encoding_table**: Optional. Displays encodings as lists for select values.
- For example, user input becomes a combo box for the field in the Field View .

For example,
AddSubField(capability_reg, "Mode Supported", 4, CFGREG_RO, "Indicates the Function modes,"), ModeEncodings);
means: Add the subfield "Mode Supported" to the parent field "capability_reg" with length 4, type CFGREG_RO, a tooltip in the Capability View, and a combo box displaying "mode encodings" for input in the Field View.

A.5 Helper File

ConfigSpaceCommon.inc include file contains useful functions for script decoding.

Appendix B: China Restriction of Hazardous Substances Table

The following tables are supplied in compliance with China's Restriction of Hazardous Substances (China RoHS) requirements:

部件名称	有毒有害物质和元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
PCBAs	X	O	X	X	X	X
机械硬件	O	O	X	O	O	O
金属片	O	O	X	O	O	O
塑料部件	O	O	O	O	X	X
电源	X	X	X	O	X	X
电源线	X	O	X	O	X	X
保护外壳(如有)	O	O	O	O	X	X
电缆组件(如有)	X	O	X	O	X	X
风扇(如有)	X	O	X	O	X	X
交流滤波器和熔丝组件(如有)	X	O	X	O	O	O
外部电源(如有)	X	X	X	O	X	X
探头(如有)	X	O	X	O	X	X
O: 表明该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求之下。						
X: 表明该有毒有害物质至少在该部件的某一均质材料中的含量超过 SJ/T11363-2006 标准规定的限量要求。						

EFUP (对环境友好的使用时间) 使用条件：参阅本手册“规范”部分规定的环境条件。

Part Name	Toxic or Hazardous Substances and Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr^{6+})	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
PCBAs	X	O	X	X	X	X
Mechanical Hardware	O	O	X	O	O	O
Sheet Metal	O	O	X	O	O	O
Plastic Parts	O	O	O	O	X	X
Power Supply	X	X	X	O	X	X
Power Cord	X	O	X	O	X	X
Protective Case (if present)	O	O	O	O	X	X
Cable Assemblies (if present)	X	O	X	O	X	X
Fans (if present)	X	O	X	O	X	X
AC Filter/Fuse Assy (if present)	X	O	X	O	O	O
Ext Power Supply (if present)	X	X	X	O	X	X
Probes (if present)	X	O	X	O	X	X
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement specified in SJ/T11363-2006.						
X: Indicates that this toxic or hazardous substance contained in at least one of the homogenous materials used for this part is above the limit requirement specified in SJ/T11363-2006.						

EFUP (Environmental Friendly Use Period) Use Conditions: refer to the environmental conditions stated in the specifications section of this Manual.

How to Contact Teledyne LeCroy

Type of Service	Contact	
Call for technical support…	US and Canada: Worldwide:	1 (800) 909-7112 1 (408) 653-1260
Fax your questions…	Worldwide:	1 (408) 727-6622
Write a letter…	Teledyne LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054-3115 USA	
Send e-mail…	psgsupport@teledynelecroy.com	
Visit Teledyne LeCroy's web site…	teledynelecroy.com/	

[This page is intentionally blank]

Index

Symbols

.lic files 248
.opt files 116
.peg files 210
.peg traffic generation files 205
.pem file 65
.pem files 65
.pex files 65, 67
.rec files 65
+ Packet # button 110

Numerics

100 ohm series resistor 21
25-pin Data Output Connector 16
40-pin Data Input/Output Connector 16
5-volt pin 21

A

AC Connector 17
Actions Properties dialog box 143
Activity 58
Add Analyzer dialog box 30
Add Counter command 147
adding
    PETracer 40
Adding an Attachment 86
adding PETracer 39
add-on cards 34
address 253
Address Space settings 237
Address Space Size field 245
Advanced Hiding Options 50
All Connected Devices command 248
All Markers Window 95
Analyzer 7
    license 248
    networked 30
    setting up 27
    update 247
analyzer
    testing 61
Analyzer Network Chat Bar command 70
Analyzer Network command 30
Analyzer Network dialog box 30
Any Event 150
Any TLP event 149
application 25
Attaching Markers 86
Auto-Configure Lane Polarity 125
Automatic ACK/NAK DLLP generation for received TLP packets 226
automatic generation 203
Available Events area 130
    127
averaging 187

B

Bandwidth 197
BAR field 245
BAR settings 245
Bars Setup dialog box 245
BARs Setup... button 245
Base Spec 1.0 Rev Compatibility Mode 125
Base Spec Rev. 1.0 Compatibility Mode 226
Beep When Trigger Occurs 123
Bitmask 148
blue current-position indicator 174
blue highlight 212
BNC Connectors 17
Both directions 176
Breakout Board 21
brown highlight 212
browsing network 30
Buffer Size 118, 119
Bus Reset button 35
Bus Utilization 158, 197
    buttons 161
    features 187
    metrics 186
    pop-up menu 159
BusEngine update 247

C

cable
    probe data 37
Cable A 15
Cable C 15
Cable Connector 35
cables 31
calculating time between DWORDs 166
Capability Structure View 244

Capability Structures 243
CATC Technical Support 253
CATC Trace 6
cells 72
  resizing 71
  states 128
Change Counter Value command 146
changing
  markers 78
channeling input signals 23
Channels 142
Chat session 70
Chat window 70
circuits 22
Clear Marker command 78
Clocks radio button 82
collapse 212
Collapse Idle 167
Collapse Idle Plus. 167
Collapsible Idle Time 165
collapsing 71
Color Format Hiding tab 109
Color pop-up menu 111
colors 110
Combining Specified Event Groups 105
Combo box 180
Comma Separated Value files 68
Command Properties window 210, 214
Comment 234
Comment field 77
comment string 77
CompeterID field 180
Completion TLP 246
components 11
configuration limitations 132
Configuration Read 246
Configuration Space 179, 241, 246
  editing 242
  Header 242
Configuration Space dialog box 179
Configuration Space Editor 241, 246
  command 241
Configuration Space Header 180
Configuration Space View 179, 180
Configuration Write 246
configuring
  Exerciser 203
  Recording Options 61
conflicts 134
Connect LED 15
Connect macro 231
  restoring 235
Connect/Disconnect button 61
connecting 31
  interposer data cable 33
  Probe Data cable 32
  USB cable 33, 40
Connector A 38
connector C 38
connectors 31
  DB-25 8
  receptacles and cables 19
contact 253
Context menu 212
Continue option 62
Continuous Time Scale 167
Control-b command 103
Control-f command 103
controls
  Analyzer ML 14
  Exerciser ML 15
Count action 131
Count field 147
Counter 142
Counters 146
counters
  setting 147
counting 146
Create new Address Space File 239
Create new Configuration Space File 241
creating
  script 207, 209
CSV files 68
ctcupa10.sys driver 25
Ctrl+N command 209
Current script position field 228
current-position indicator 174
custom circuits 22

D

Data cable 31, 32
data cable 37
Data Cable Connector 35
data cells 71
Data connector 31
Data Field 71
Data Flow command 169
Data Flow window 169
Data In/Out connector 21, 22
Data Input/Output Connector 16
Data Output Connector 16
Data Throughput 181, 197
data_pem_files directory 63

data.pem file 63
data.pex file 62, 65
dataXYZ.pem files 122
DB-25 connector 8
decode levels 79
decoding 79
default options file 126
default.opt file 116
default.rec file 126
delimiters 174
Description String 142
descriptive label 126
Device Emulation 226
Device Emulation Interposer
  installing 36
device emulation interposer 34
DeviceID field 180
devices
  connecting to 34
Direction 207
Direction field 105
Disable Descrambling 125
Disconnect macro 231
  restoring 235
Display area 44
Display Configuration Name 109
Display License Information command 248
Display Options 107
  command 107
  dialog box 107
  fFiles 65
  loading 116
  saving 116
Display Options button 107
DLLP Packet Properties dialog 145
Do not export hidden packets 207
Do not export Idle packets 207
Do not save hidden packets option 67
Do not send TLP packet if credit amount is insufficient 226
Downstream direction 176
Drag an event here to create a new sequence 128
drive strength 23
dual analyzer system 29
DWORD 148
DWORDs
  timing 166

E

Edit as Text command 210
Edit Code 234
Edit code... button 233, 234
Edit Comment command 69
Edit Generation Macro Icon dialog box 233
Edit Icon... button 233
Edit Marker 94
Edit Marker command 78
Edit Marker for Packet # pop-up 77
editing
  macros 234
  script 212
electrical idle 203
e-mail 253
Email CATC Support 253
Emulation Interposer
  installing 36
emulation interposer 34
Emulation Test Fixture 35
  installing 36
emulation test fixture 34
Enable Automatic Skip Generation 226
Enable Outlining 216
Enable Tool tips 108
environmental conditions 18
Error Log 210, 215
Error Properties dialog box 143
Error Summary dialog box 155
error types 143
Errors 215
Errors pane 173
event
  counting 146
Event Groups menu 105
Event Icon Preview 142
Event Navigation 157
Event Properties dialog box 142
Event Trigger recording type 119
events
  searching 81
Event-specific Settings 143
Exclude option 105
executing 228
Exerciser 9, 13
  configuring 203
  setting up 28
expand 212
Expand Data command 71
Export Wait for ACK from upstream 208

Export Wait for Cpl from upstream 208
exporting 68
    Trace to a Traffic Generation File 207
Ext. In Connector 17
Ext. Out connector 17
External Interface Breakout Board 21
external signals 23

F

fax number 253
field
    hiding 113
Field Colors tab 110
Field Formats tab 112
Field View 244
File Export dialog box 207
file formats 68
File Information window 154
File Menu 51
File Tabs 215
File tabs 210
filter 151
Filter action 131
Filter In button 151
Filter Out button 151
Find command 104
Find dialog box 104
Find Next command 106
finding 104
Firmware update 247
First, Prev, Next, and Last buttons 180
Fit to Graph Area 159, 192
flow control 204
Flow Control tab 226
Flush option 62
Fonts 108
format
    field 112
From 207
From packet # field 69
From Packet field 67
front panel 14, 15
Functionality of Markers 84
fuse 17

G

General page 226
General tab 61, 107, 118, 218
Generate Menu 53
Generate menu 231
generating 203, 228
    theory 203
Generation Macro command 234
Generation Macros command 232
Generation Macros dialog box 232, 234
Generation Options command 217, 226
Generation Options dialog box 217, 226
Generation Status bar 58
Generator file format 68
GenScriptMacros directory 233
Global State 128
Global State Cell 130
Go To Marker command 82
Go to Marker command 166
Go To menu 102
Go to Packet # 159
Go to Packet command 81, 82
Go to Script Editor 213
Go to Trigger command 81
Grid Lines 157
ground pins 21
Group and Colors column 110, 112

H

hardware 3, 5
    specifications ML 18
hardware failure 27
hardware wizard 27
header fields 74
Help Menu 56
Hexadecimal vs. Binary tabs 180
Hide 159, 192
Hide buttons 49, 166
Hide Downstream button 49
Hide SKIP and Update FC button 49
Hide Training button 49
Hide Upstream button 49
hiding 113, 114
    Idles 166
Hiding tab 114
Hierarchy Lines 108
host controllers 34
Host Emulation 226
    adding PETracer 40
Host Emulation Test Fixture 35
    installing 36
host emulation test fixture 34
host machine 11
host machine software requirements 20
humidity 18

I

Icon 234
Icon Label 142
idle 203
Idle errors 143
Include files 208
Include statement 205
Include statements 215
information
  priority 175
Inhibit Channel 124
InitFC complete status 194
InitFC State 229
InitFC State segment 59
input signals 23
Install Software command 25
installation 25
installing interposer 32
Integrity tab 221, 226
Intellisense 212
interface 25
internal rules 134
interposer 34
  installing 32, 36
interposer data cable
  connecting 33
Interposer options 226
Interposer probe 31
Intersection option 105
Invalid Configuration status 132
Invert Polarity 124
IP LAN 29

K

Key
  License 248
keyboard shortcuts 57
keystrokes 57

L

label 126
LAN 29
Latency 197
Latency Time 181
Latency Time at Split Transaction level 186
Layout 210
layout 44
LeCroy PETracer command 25
LEDs
  Analyzer ML 14
  Exerciser ML 15
Legend option 174
level hiding 114
Level Hiding tab 114
levels 79
license files 248
License Information window 248
License Key 248
licensing information 248
limits 132
Linear 159, 192
Link Connect toolbar button 203
Link level decode 79
Link section 61, 124
Link Settings 118
Link State 194, 229
link state messages 59
Link State segment 59
Link tab 220, 226
Link Tracker
  buttons 167
  toolbar 163
Link Tracker window 163
  docking 165
  markers 166
  reformat 164
link training 61, 204
Link Training sequence 203
Link Transaction
  metrics 185
Link Transaction Level graphs 188
Link Transaction Performance 185
Link Up LED 15
Link Utilization 197
Link Width 124
Link Width pane 173
Linkup.peg file 227
List values 212
Load button 116, 126
Load command 116, 126
loading 116, 126
log 215
Logarithmic 159, 192
logic analyzers 21
long format 71
loop 29
LTSSM Flow Graph 176
LTSSM Flow Graph command 176
LV TTL output and input signals 21

M

macros 231
  changing order 234
  creating 232
  deleting 235
  editing 234
Main Display Area 163
Main display area 127
manual
  trigger switch 18
Manual Trigger
  recording type 119
Manual Trigger push-button 14, 15
Markers 83
  Adding an Attachment 86
  Attachment Types and Visualization 88
  Embedded Attachments to a Marker 88
  Recording an Audio File 87
  Video Files supported 87
markers 77
  deleting 78
  editing 78
  setting 77, 166
Markers Overview 83
Mask (hex) entry 149
Match (hex) entry 149
MB Segments field 63
memory requirements 19, 20
Memory Write event 150
Memory Writes 185
Memory Writes Performance 197
Memory/IO Space Editor 239
Menu bar 44
menus 51
  pop-up 72
metrics 181
  Bus Utilization 186
  Link Transaction 185
  Link Transactions 181
  Split Transaction 184
  Split Transactions 181
  trace 182
  Traffic Summary 184
  unit-base averaging 187
Metrics Header 182
Metrics Tooltip 182
Misc 118, 123
motherboards 34
Msb -> Lsb checkboxes 113
Multi-Lane verification system 3
Multisegment
  viewing 122
Multisegment recording 63
Multi-Segment Toolbar 47
multi-segmenting 63

N

Name 234
navigating 170
Navigator 170
  displaying 170
  legend 174
  panes 171, 173
  range 171, 172
  ranges 171
  slider 174
  toolbar 171
Navigator Legend dialog box 174
Navigator Panes button 174
Navigator Range button 172
Network Browse list 70
networked Analyzer 30
networking 29
New button 232
New Event button 130
New Events button 142
New PETrainer Script 209
Number of data packets 194
Number of Link Transactions 181
Number of Packets 181

O

Offset dword 148
Offset field 243
Open existing Address Space File 239
Open existing Configuration Space File 241
opening
  program 26
operating temperature 18
options files 126
Options Name 118, 121
Options Name box 126
Ordered Set Properties dialog box 146
Origin field 105
outlining 212
overview 3

P

package contents 18

Packet # 110
Packet # field 77
Packet Data command 178
Packet Data window 178
Packet Directionality Cell 75
Packet errors 143
Packet Header bar 177
Packet Header Cell 76
Packet Header command 177
Packet Heading Cell 75
Packet level decode 79
Packets/second 197
pane checkbox 174
Payload 181
payload pattern match 148
Payload Properties dialog box 145
Payload size 194
Payload tab 148
PC 25
PCI Configuration Space Header 242
PCI Express
  adapter card 34
PCI Express Multi-Lane advanced verification system 3
Pending Requests at Split Transaction level 186
Periodically schedule UpdateFC DLLP 226
PETracer
  options 118, 120
  setting up 27
PETracer EML
  opening 26
PETracer ML 7, 11, 12
  opening 26
PETracer SN message 58
PETrainer
  setting up 28
PETrainer ML 9, 11, 13
petranx4.sys driver 25
petrcrml.sys driver 25
Pin Button 142
pin-outs 22
pins 23
Playback Window 100
Playlist Functionality 98
Playlist Playback Control 100, 101
Plug-and-Play instructions 27
plus symbol 110, 112
pop-up menus 72
Port 1 39, 124
Port 2 39, 124
Position Trace view on packet x 213
power
  requirements 18
  switch 18
power LED 15
power on/off switch 17
power socket 17
Power Switch 35
Pre/Post Trigger pane 173
Prefetch field 245
Preserve TC to VC mapping across the channels 123
Print command 69
Printer button 69
printing 69
Probe Data Cable
  attaching 38
Probe Data cable 31, 32
  connecting 32
probe data cable 37
Probe Data Connector 14
Probe Data connector 31
probing characteristics 19
product
  overview 3
program
  opening 26
progress 204
Properties 160, 192
Properties button 142
Properties command 130
Properties dialog 142
Properties dialog box 130, 141
protocol unit 181
prototype rework area 22
PWR indicator LED 14, 15

R

range delimiters 174
Raw 10b Codes 73
Read Address Space button 237
Read Address Space dialog box 238
Read Requests Performance 184
reading 71
Ready message 58
Real-Time Statistical Monitor window 192
Real-Time Statistics
  buttons 190
  pop-up menu 192
  toolbar 190
Real-Time Statistics window 189, 229

Real-time Statistics window 193
rear panel 16
REC (recording) LED 14
Recently Used Ranges 172
Record button 62
Record Menu 52
recorded activity 60
recording 61, 117
    memory size 19
    multi-segment 63
    stopping 62
Recording button 131
Recording LED 14
Recording Options
    command 117
    configuring 61
    dialog box 117
    files 65
    loading 126
    saving 126
    settings 126
Recording Options command 61
recording progress 60
Recording Progress Bar 58
Recording Rules
    buttons 129
    examples 134
    limits 132
    logic 134
    toolbar 129
Recording Rules tab 127
recording status 60
Recording Type 118, 119
Reference Clock 35
remote operation 29
Remove 159
Report Menu 53
Report menu 153
reporting 20
reports 153
Reset button 35
Reset Column Widths 165
resizing 71
Response Time 181, 197
Response Time and Latency Time at Split Transaction level 186
Response Time at Link Transaction level 186
Response Time at Split Transaction level 186
restoring
    icons 235
Resume Generation button 228
Reverse Lanes 124
Right click cell context menu 108
Row Selection 157
RS-232 25-pin Data Output Connector 16
RS-232 40-pin Data Input/Output Connector 16
rules
    internal 134
Run LED 15
Run verification scripts command 198
Rx Cable C 15, 38

S

Save all included files 208
Save As command 67
Save As Default 116, 126
Save As Default. 126
Save As MultiSegment Trace 118, 122
Save as Multisegment trace 63
Save button 116
Save External Interface Signals 123
Save packet range command 67
saving 67, 116, 126
    script 208
script 228
    creating 207, 209
    editing 212
    executing 204
    macros 231, 232
    running 227
    saving 208
script comment 232
Script Edit Window 212
Script Edit window 210
Script Editor 206, 210
    toolbar 211
    tooltips 212
Script Editor button 210
Script Editor toolbar 210
script icon 232
script name 232
Script properties area 232, 234
scripts 203
    memory size 20
Search 58
    command 81
Search Bwd message 103
search direction 60
Search Direction command 103
Search For menu 104
Search Fwd message 103

Search Menu 54
searching 81
Seconds radio button 82
segmenting 63
segments
    viewing 122
segments.col file 64
Select command 30
self-diagnostic testing 27
Send command 70
Sequence Cell 130
Sequence State 128
servicemarks ii
Set Display Options command 110
Set Marker command 77, 166
Set Range Near Packet xxx 172
Set Range to Whole Trace 172
setting markers 77
Settings button 199
Settings window 199
Setup Menu 52
short format 71
shortcuts 57
Show Configuration Space for xxxx 180
Show Header Fields command 74
Show Header Fields dialog box 74
Show icon on the toolbar 234
Show Line Numbers 216
Show Number of Transitions checkbox 176
Show Raw 10b Codes command 73
Show Tooltips 216
signal descriptions 22
Signal Level switch 35
Size field 245
Slot Interposer probe 31
small triangle 71
Snapshot recording type 119
software 43
    installation 25
    update 247
specifications
    ML 18
Specify Action command 131
Split level decode 79
Split Transaction
    metrics 184
Split Transaction Level graphs 187
Split Transaction Performance 184, 197
StandardSettings.rec file 121
Start generation button 204
Start menu 25
Start Traffic Generation button 228
statistics 20
Statistics Accumulation area 193, 229
status
    LEDs 19
Status Bar 58
    macros 231
Status bar 44, 204
Status indicator LED 14, 15
Status LED 14
Status segment 58
Stop button 62
Stop Generation button 228
Stop option 62
stopping recording 62
storage temperature 18
support 253
Swap Recording Channels 125
switches 18
Synchronize Trace View 167

T

Target Analyzer 118, 120
Technical Support 253
telephone number 253
temperature range 18
Test Fixture 35
    installing 36
test fixture 34
testing 61, 203
text files 68
theory 203
Throughput 197
Throughput at Link Transaction level 186
Throughput Per Transaction at Split Transaction level 186
Tight Columns 157
time between DWORDs 166
Time Coverage 197
Time Stamp 108
time value 166
time-based averaging 187
Timestamp at the beginning 108
Timing and Bus Usage Calculator 196
Timing Calculations command 196
Timing Calculator dialog box 196
Title bar 44
TLP Header Properties dialog box 144
TLP Prefix Properties dialog box 144
TLP transactions 246

TLP type 148
To 207
To Exerciser 35
to Generator File Format 207
To packet # field 69
To Packet field 67
Toggle Outlining 216
Tool tip Display 165
Toolbar 45, 127
    44
Tools Menu 56
Tools menu 153
Tooltips 57
trace
    cells 72
    exporting 68
    files 65
    metrics 182
    saving 67
Trace Filename & Path 118
Trace Filename and Path 120
Trace Viewer 26
Trace Viewing Level 108
traces
    searching 81
trademarks ii
traffic 71
    analyzing 153
    generating 203, 228
traffic generation
    macros 231
traffic generation files 207, 210
traffic generation prep 227
Traffic Generation Toolbar 48
Traffic Speed pane 173
Traffic Summary
    buttons 157
    metrics 184
Traffic Summary window 156
    moving to packets 156
Traffic Type pane 173
Trainer links 59
TRG (triggered) LED 14
triangle 71
trigger
    basic events 19
Trigger action 131
Trigger Position 118, 120
Trigger push-button 14, 15
Triggered LED 14
triggers
    count 146
TTL output and input signals 21
Tx Cable A 15, 38

U

Undo Zoom 159, 192
Union option 105
unit 181
unit-based averaging 187
Universal Protocol Analyzer System 12
UPAS 12, 14
UPAS 10K 12
Update Analyzer dialog 247
Update command 247
Update Device command 247, 248
Update License command 248
Update License dialog box 248
updates 247
UPLD (Upload) LED 14, 15
Upload LED 14, 15
Upload Size 118
Uploading 58
Uploading data message 60
Upstream direction 176
USB cable
    connecting 33, 40
USB drivers 25
USB Type B Host Machine Connector 16
Use External Reference Clock 125
User input 204

V

Verification Script dialog box 198
View Data Block command 72, 73
View Menu 55
View Options 167, 211
View Options button 165, 216
View Settings 161
Viewer 26
Viewing Attachments of a Marker 89

W

Wait commands 204
wait conditions 20
Warnings 215
web site 253
Website, CATC 253
whether or not to show script icon 232
Window Menu 56

Windows hardware wizard 27
Wrap 108
Write Address Space button 237
Write Address Space dialog box 238
Write Requests Performance 184
Writes Response Time 188
Writes Throughput 188

Y

Y Scale Type 159, 192
yellow range delimiters 174

Z

zoom 164
Zoom Level 108
Zoom to Trace View 159